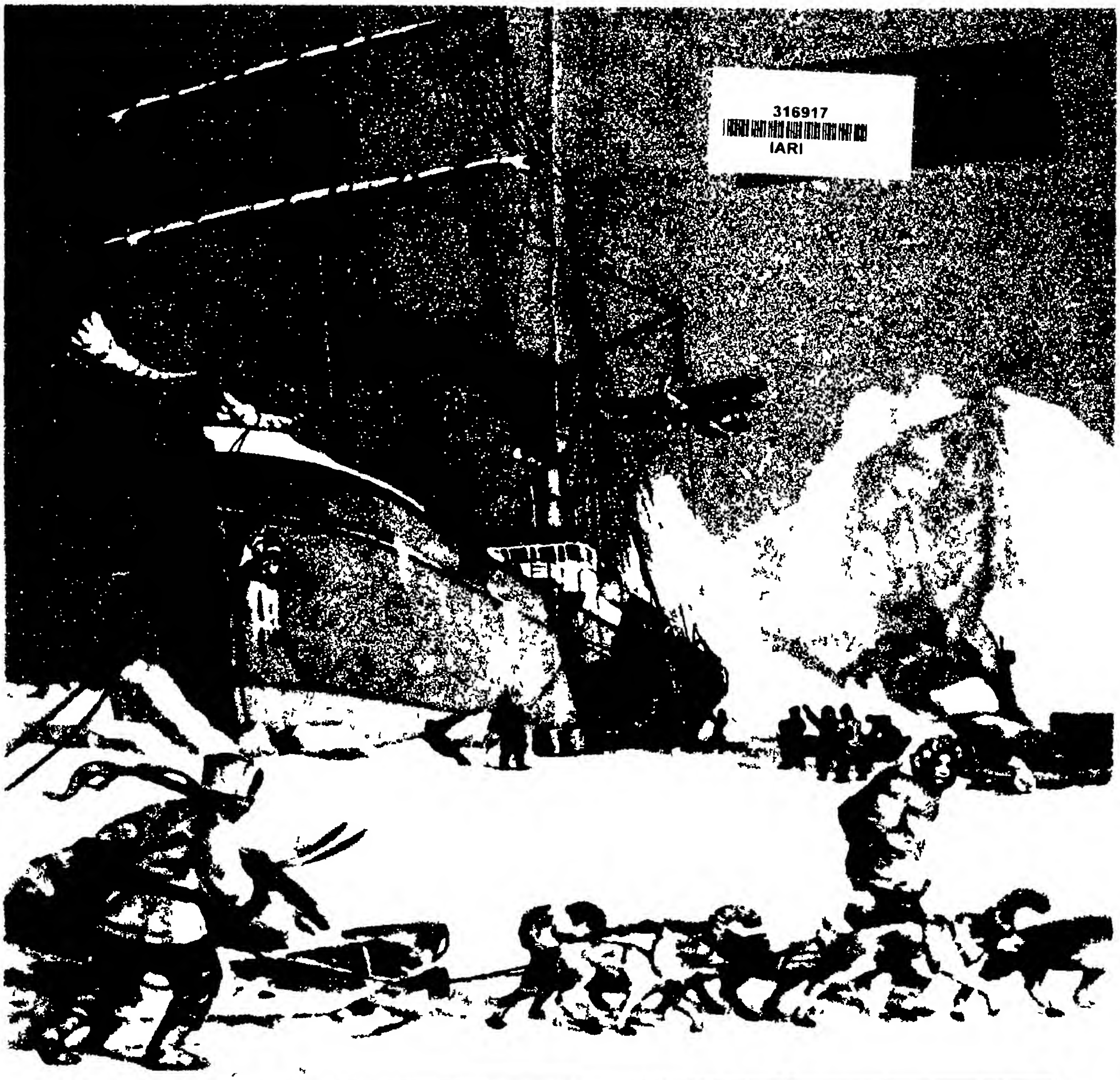
SCIENTIFIC AMERICAN

The Monthly Journal of Practical Information

35¢ a Copy JANUARY 1922 $4.00 a Year



WITH AIRPLANE AND DOG SLED: SIR ERNEST SHACKLETON'S NEW ANTARCTIC EXPEDITION IN THE FAR SOUTH [See page 35]

Scientific American Publishing Co., Munn & Co., New York

Chart of Recommendations

How to Read the Chart:

THE correct grades of Gargoyle Mobiloils for engine lubrication of both passenger and commercial cars are specified in the Chart below.

A means Gargoyle Mobiloil "A"
B means Gargoyle Mobiloil "B"
E means Gargoyle Mobiloil "E"
Arc means Gargoyle Mobiloil Arctic

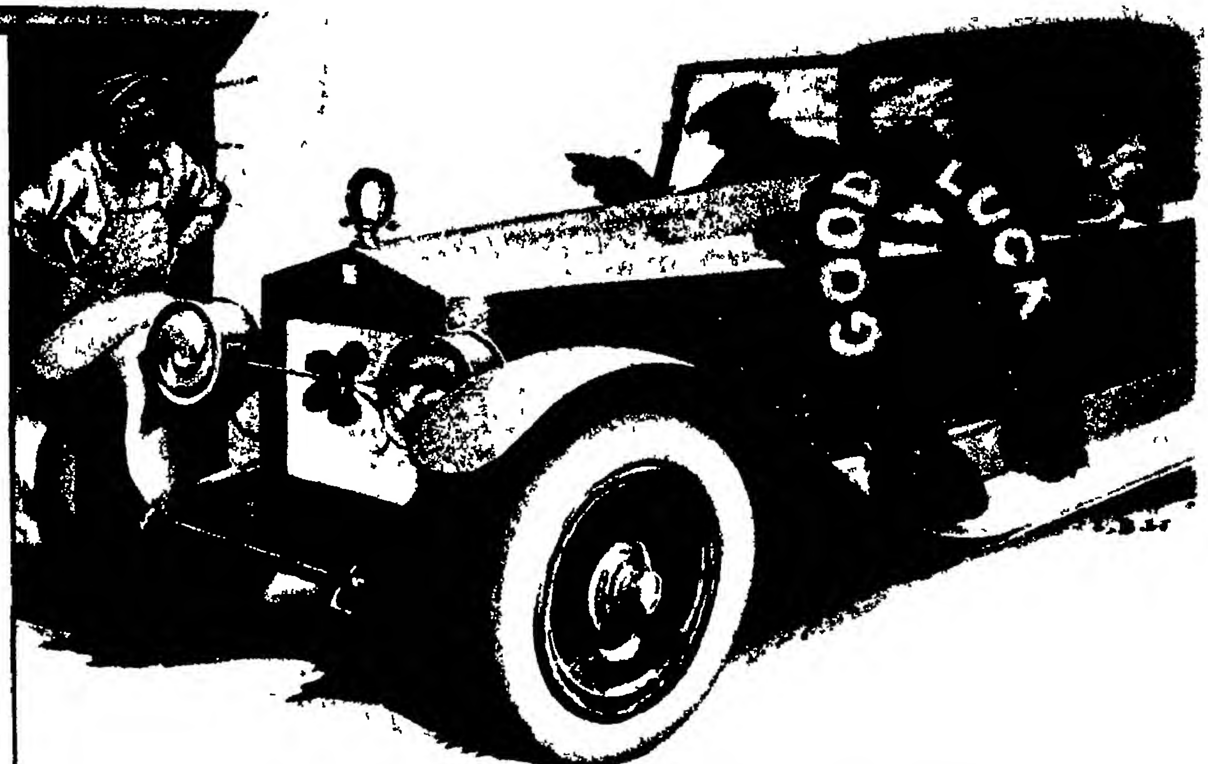
Where different grades are recommended for summer and winter use, the winter recommendations should be followed during the entire period when freezing temperatures may be experienced.

The recommendations for prominent makes of engines used in many cars are listed separately for convenience.

The Chart of Recommendations is compiled by the Vacuum Oil Company's Board of Automotive Engineers, and represents our professional advice on correct automobile lubrication.

NAME OF AUTOMOBILES AND MOTOR TRUCKS	[illegible]		[illegible]		[illegible]		[illegible]		1917	
	Summer	Winter	Summer	Winter	Summer	Winter	Summer	Winter	Summer	Winter

Prominent Makes of Engines



"GIVE ME A QUART OF OIL"

Blind Luck—or Science. Choose!

BY SAYING "Give me a quart of oil" you may accidentally get correct lubrication. But you are taking a long chance

If you are one of the many who know the satisfaction of using Gargoyle Mobiloil we advise you to avoid this careless request

Your best insurance of *engine results* is to ask for Gargoyle Mobiloil, being particular to specify the correct grade for your car.

The careless request, "Give me a quart of oil" means:

"Oh, I don't care who made the oil.

"I don't care how much carbon I get.

"I don't mind overheating, rapid depreciation, noise or repair bills."

You are matching blind luck against lubrication science.

Why correct lubrication is decidedly cheaper

During this very day, mechanics are busy repairing thousands of automobile engines. They are cleaning out carbon, fitting in new piston rings, putting in new bearings, regrinding worn cylinders

At least 50% of these repairs were made necessary by bad lubrication—by the old haphazard—"Give me a quart of oil"

Not a gasoline by-product

Nine out of ten lubricating oils on the market are simply by-products in the manufacture of gasoline Gargoyle Mobiloil is *not* a by-product

It is produced by lubrication specialists who are recognized the world over as leaders in lubricating practice. Gargoyle Mobiloil is manufactured from crude oils chosen for their *lubricating* qualities—not for their gasoline content They are manufactured by processes designed to bring out the highest *lubricating* value—not the greatest gallonage of gasoline.

This is one of the essential reasons for the superiority of Gargoyle Mobiloil.

GARGOYLE

Mobiloils

A grade for each type of motor

Domestic Branches: New York (*Main Office*), Indianapolis, Boston, Minneapolis, Chicago, Buffalo, Philadelphia, Des Moines, Detroit, Dallas, Pittsburgh, Kansas City, Kan.

VACUUM OIL COMPANY

Scientific American, January, 1922. Volume 126, Number 1. Published monthly by Scientific American Publishing Company at 233 Broadway New York, N Y Subscription price, $4.00 per year. Entered as second-class matter June 18, 1879, at the post office at New York, N. Y., under the act of March 3 1879

With the Editors

WITH this issue, the third of the new monthly SCIENTIFIC AMERICAN, we are finding our stride, so to speak It is no simple matter to change the habits of years after having edited a weekly journal of popular appeal and a supplementary serious monthly review, we found it a little difficult, at first, to readjust ourselves to a single monthly journal combining the aims and ideals of both of our former publications. But what with the experience gained with each issue, together with the worthy suggestions of many of our friends and readers, we believe this new journal of ours is being rapidly molded into the kind of periodical that satisfies both the layman and the professional scientist After all it is your magazine, edited for you and the editorial ear is ever listening for suggestions and criticisms that throw light on what you wish the SCIENTIFIC AMERICAN to be, in order that it will prove most indispensable at your desk, work bench, or in the library

OUR editorial pages in this issue are devoted to a review of the past year This double-page review has long been a feature of the SCIENTIFIC AMERICAN In our former weekly the review of the year appeared in the first issue of the new year We have always felt that this condensed résumé of the progress and achievements of the year just brought to a close served as nothing else would to check up on past performances for the benefit of the reader and ourselves alike Why for ourselves? Just a word to clear this point Living so close to the columns of the SCIENTIFIC AMERICAN, it is virtually impossible for the editors to develop a real perspective while any issue is still fresh in our minds But—after an issue has been left six months or a year behind and its contents have been largely forgotten the editors can critically read their own handiwork, being for the time, in the position of the reader For the moment we place ourselves on the other side of the publishing business, we review our own work from the reader's point of view, we learn with what degree of clarity we have described something which seemed quite simple to us who had seen it, we have an opportunity of criticizing our own efforts and improving our work All of which is a good thing Therefore, we welcome the review of the year

OUR list of editors, contributing editors and so on appearing on this page, reveals the presence on our staff of a goodly number of specialists. Apparently, however, it does not tell the whole story Certainly it does not make it clear that one of us is rather absorbed in the study of old architecture, that another is a good deal of a motion picture authority—his hobby, in fact, is making motion picture films, that we have with us an enthusiastic collector of Dickensiana Nor is this all. In casual conversation the other day it developed that one of the staff is a philatelist of parts, with an intimate knowledge of stamp markets, stamp frauds, and numerous other things of the sort The conversation turned to counterfeits and counterfeiters, the sort of fakes that they try to foist off upon the collector, and the means employed to show these in their true character It hadn't occurred to the philatelic member to suppose that anybody but a collector of old stamps would be interested, but his story made such a profound impression on the rest of the staff that he was at once called upon to tell it to our readers as well. This he has done. And he makes it plain that he has only begun to tell about the curious sidelights of his hobby and that if you like the story he puts before you now there is more material to draw upon

ONE afternoon not so very long ago, business in this office was just about suspended while stenographers and editors, office boys and department heads gathered about one of the editorial rooms, from which the most amazing noises issued Blood-curdling shrieks alternated with low moans and loud clankings lions roared, dogs barked shots were heard, and pandemonium in general had apparently broken loose Initial suspicions that we were haunted broke down before the revelation that one of the editors had brought in a collection of noise-making properties that are used in connection with motion picture presentations We gathered about the collection appropriated the instrument with whose particular variety of racket we were most impressed and proceeded to distribute the uprising somewhat We are sorry we cannot print the sound waves and give some real idea of the delightful manner in which the artificial lion bellowed

HAD Mr Hughes' surprising attack upon the problem of naval establishments come a little earlier it might have led us into omitting from this issue the statement by Mr Bywater of Japan's program and her measure of accomplishment But this part of the issue was on the press when Mr Hughes made his address, so we could only hope that the progress of the conference would be such that we might be able to say an intelligent word of comment on this page—the last one to go to the printer Another of those kaleidoscopic changes may completely shift the scenes but we write these words at a moment when it seems fairly clear that most of the delegates have come to Washington prepared to be very enthusiastic about general disarmament

WE started something In one of the concluding issues of the weekly régime our automobiling member expressed some pointed opinions about the efforts made to light our highways for night traffic It will be recalled that he summed up the situation by giving it as his experience that every style of highway lighting yet displayed was at best confusing and often dangerous that his own preference was all for the highway completely unlighted save by his headlights This Phillipic brought a prompt visit from the genial gentleman who keeps us informed of what the big Schenectady research laboratories are doing—yes, we suppose he would have to answer to the title of *Press Agent* if anyone were to insist upon it. He told us that we had published this editorial right at the moment when the illuminating experts of his company had perfected what they considered to be the ultimate in highway illuminating These folks, he reported, were all worked up about the matter, and were sure that if we would only come up and inspect the installation we would be convinced We are willing to try anything once so we went. *And we were convinced In the February* issue we shall tell you all about it—what the new system is, how it works, and what it does. Right here, by way of indicating that *the subject is of interest and importance* we will say that the road is lighted so that one can see a cat crossing it nearly half a mile away, and at a cost hardly in excess of that of the familiar ineffective lighting

CONTENTS

JANUARY, 1922

LEADING ARTICLES

SHORT ARTICLES

DEPARTMENTS

SCIENTIFIC AMERICAN PUBLISHING COMPANY

Munn & Company, 233 Broadway, New York

Founded 1845

CHARLES ALLEN MUNN, President ORSON D MUNN Treasurer
ALLAN C HOFFMAN Secretary

Vol. 126, No. 1 Published monthly Entered as second class matter June 18 1879 at the post office at New York, N Y under the Act of March 3 1879

Price, 35 cents a copy $4.00 a year Postage prepaid in United States and possessions, and Mexico, Cuba and Panama; $4.50 a year for Canada. Foreign subscriptions, $5 00 a year postage prepaid.

TIMKEN *Tapered* ROLLER BEARINGS

Friction

Friction, from the beginning of time, has controlled man's progress, either as a friend or as an enemy.

Earliest evidence of the friendly use of friction was the rubbing of the hands and body to keep warm and finally the rubbing of a pointed stick to start a fire But friction, like the fire which it starts, is, in many ways, man's formidable enemy.

In the operation of machinery and in the development of all automotive vehicles, friction must be held absolutely under man's control, or else, the mechanical power which has carried man from savagery to his present high estate, would be so wasted as to hold progress and development at a standstill.

Without anti-friction bearings (as they are called) machinery in general would have remained as in great-grandfather's day No railroads would streak across the land—no motor cars—no trucks—not even power-driven boats could ply.

In this battle, against "enemy" friction, human inventive genius has progressed rapidly from the early cumbersome types of soft, slippery metal collars which encircled axles and shafts—through various applications of balls and rollers—to the tapered roller bearing of today, as typified in the product of the Timken Roller Bearing Company;—

It has progressed from those early nuisances that required greasing or oiling every few hours to the Timken Tapered Roller Bearing of today that requires attention as infrequently as every year or two

Here we have a light, compact, and self-contained device that is friction's absolute master. For not only do Timken Tapered Roller Bearings hold friction to a negligible minimum—

But in so enabling wheels and shafts to revolve at frightful speeds with ease and safety—

Timken Tapered Roller Bearings, at the same time, carry all the loads that may be thrust upon them regardless of the direction from which these loads may come. No matter how, nor where, nor when that shock or load is applied—

Your Timken Tapered Roller Bearings rest snugly in their various housings, absorbing or deflecting those blows—

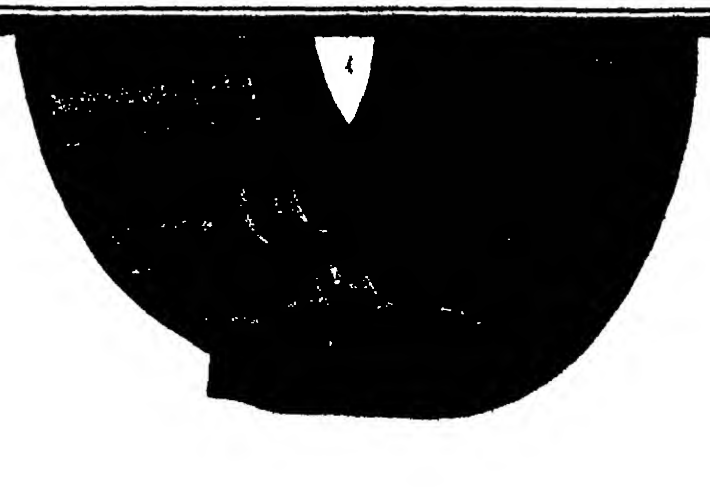
The while your motive power is being delivered through these bearings, without interruption, to the driving wheels.

And finally, when that wear which *must* follow all motion becomes apperent,—a simple adjustment and your Timkens function as when new.

THE TIMKEN ROLLER BEARING CO, CANTON, OHIO

Timken Tapered Roller Bearings for Passenger Cars, Trucks, Tractors, Trailers, Farm Implements, Machinery, and Industrial Appliances

SEND FOR TRUTH-TESTED FACT #2, "FRICTION"

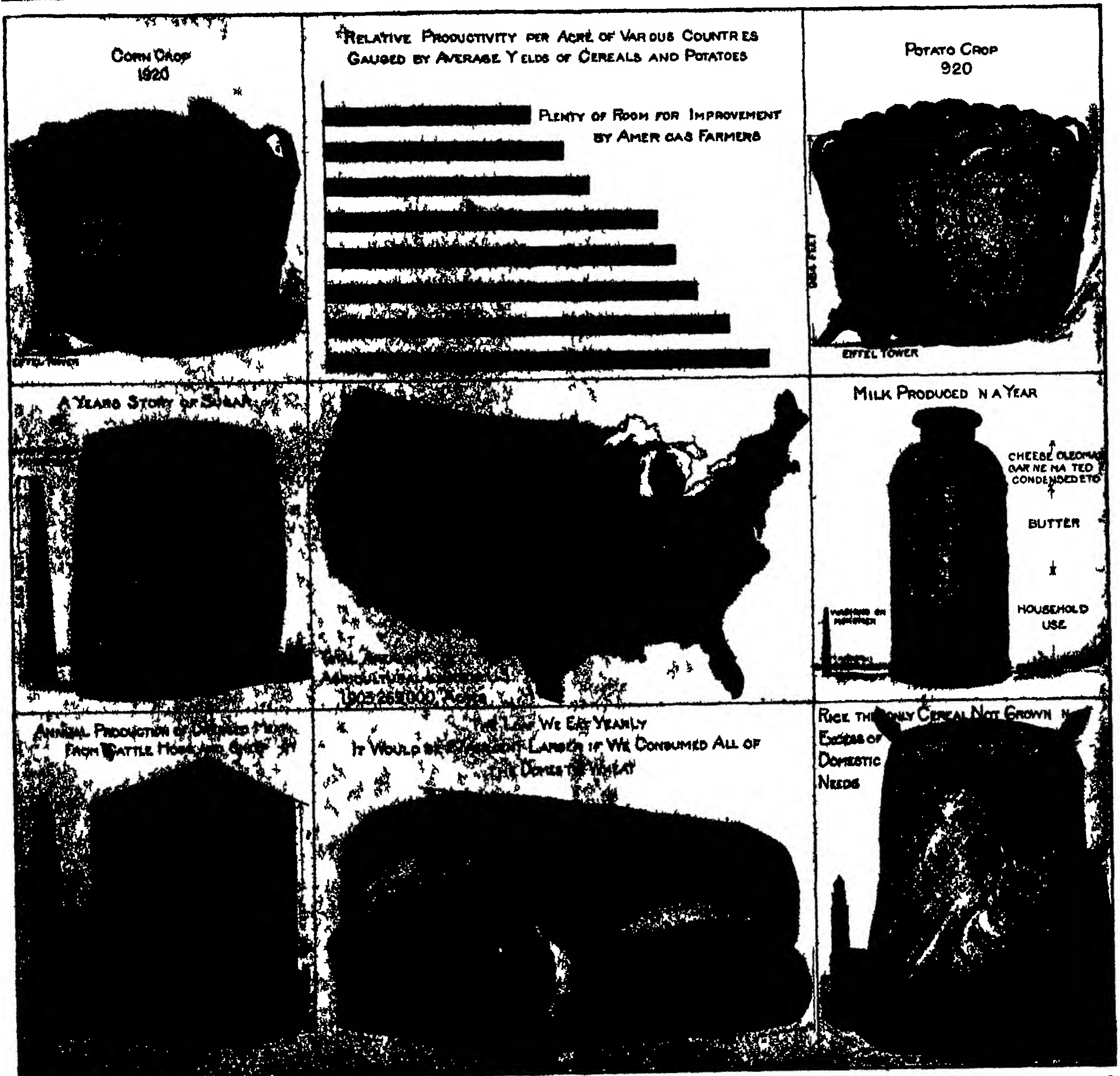


SEVENTY-SEVENTH YEAR

SCIENTIFIC AMERICAN

THE MONTHLY JOURNAL OF PRACTICAL INFORMATION

NEW YORK JANUARY 1922



OUR FOOD PRODUCTION AND CONSUMPTION AT A GLANCE: FACTS AND FIGURES ON OUR LEADING FOODSTUFFS, PRODUCTIVITY PER ACRE, AS COMPARED WITH OTHER NATIONS, AND RELATIVE AREAS OF PRODUCTIVE LAND AND CULTIVATED LAND. THE EIFFEL TOWER, WASHINGTON MONUMENT AND WOOLWORTH BUILDING ARE EMPLOYED AS STANDARDS FOR COMPARISONS.—(See pages 6 and 7)

America's Domestic Food Supply

In Which We Take Inventory of Our Needs and How Far They Are Supplied by Home Production

By Robert G. Skerrett

THE people of no other nation can boast a dietary as abundant and as varied as that of the dwellers in the United States, and the most suggestive aspect of this matter is that with few exceptions the vast bulk of these comestibles is of domestic production

Provided the farmer's labors can be made worth his while, our natural agricultural resources are such that we can take care of hundreds of millions of citizens more than we have within our gates at the present time The problem is essentially a better and fuller use of the arable acres at our disposal In this, science and engineering will play in the future larger parts than they have in the past.

To-day, the average American requires for the preparation of his three meals raw products totalling about four pounds, and, itemized, these are apportioned as follows

Bread, 16 ounces, meat, 8 ounces, lard 1 42 ounces, milk, 16.3 ounces, vegetables, 12 ounces, fruit, 9 ounces, and sugar 4 ounces

The distribution of these vital commodities among a population of 105,000,000, scattered throughout the length and breadth of the land, is a business of immense proportions which calls to its aid agencies of various sorts and of a highly developed character in certain instances Without these facilities the bounty of one section of our land could not be placed at the disposal of another, nor could the overflow of one season be made available during the months of natural scarcity —THE EDITOR.

HOW far is America's market basket filled from her own resources? Is the domestic food problem one that need cause us any alarm?

These questions are persistently recurrent, and are generally asked more frequently when the cold of winter grips the land and our arable acres cease, in large part, for the nonce to be actively productive True, the sea, some inland waters, the range, and the barnyard continue to supply us with great quantities of food stuffs year in and year out, but the main burden of sustenance rests upon the seasonal crops that are grown and harvested mostly during the prevalence of warm weather

It is doubtful if the average citizen gives more than a momentary heed to the sources from which his daily diet is drawn, and taking the country by and large the public is generally ignorant of the immense amount of provisions that must be continually available in order that the physical wellbeing of the nation may be maintained at the proper standard. No matter how we may view the importance of our manifold industries, it is indubitably a fact that agriculture is the greatest of all of these activities. Indeed, it is the foundation of the nation's prosperity, for the very life and vigor of everyone is conditional upon plenty of good and nourishing food.

The biochemist has told us how many calories the food eaten daily by man, by woman, and by child should contain to meet bodily requirements under various circumstances of occupation, and this expert has taken pains to detail how the several percentages of nutritive elements can be obtained variously from divers edibles. Again, the more practical-minded student of the subject has explained that the average adult needs between 2½ and 4 pounds of foodstuffs every twenty four hours to furnish a sufficiency of protein, fat, and carbohydrates. In passing, let it be recalled that the youth of both sexes demand quite as much at some periods to appease their appetites as do grownups. As a matter of fact our per capita consumption amounts daily to 4 1 pounds, and this calls for provender totalling 215,250 tons, or the annual providing and distributing of 78,566,250 tons of foodstuffs!

The American public spends $18,000 000,000 on its table each twelvemonth, or $49,315,000 per diem, and we are authoritatively informed that out of this stupendous sum 31 per cent is spent for bread sugar potatoes, and fruit, while 69 per cent is devoted to the purchase of meat, fish eggs, milk, butter, cheese, and lard. The major part of these comestibles are produced by the 6,448,366 farms in the United States, and the area involved embraces an aggregate of 955,676,545 acres. The owning and the operating of these farm lands represent a capital investment of $80,000,000,000 and the value of the annual output is in excess of $20 000,000,000

Stupendous as these figures are still they probably fail to bring home to most of us what they stand for in measures of foodstuffs. However, data are available which give the information desired and reveal at the same time how much it takes to nourish this nation and to have, besides, a surplus of some commodities for export The work of our farmers during 1920—a year typical of large crops generally, resulted in an abundance of food for ourselves, great quantities of feed for our domestic animals, and a vast amount of raw materials for the fabrication of clothing Our cultivated acres yielded 787,128,000 bushels of wheat, 3,232,367,000 bushels of corn, 1 526,055,000 bushels of oats, 202,024,000 bushels of barley, 69,318,000 bushels of rye, 13,789,000 bushels of buckwheat, and 53,710,000 bushels of rice, not to mention about 150,000,000 bushels of grain sorghums. In all, more than 6,000,000,000 bushels of cereals.

Further, our farms grew during the year mentioned a white-potato crop aggregating 430,458,000 bushels, while the sweet potatoes raised reached a total of 112,368,000 bushels. Of beans we had for distribution 9 075,000 bushels, of onions 19,119,500 bushels, and our markets handled 820,750 tons of cabbage. Beside these staple vegetables, the so-called truck crops furnished us with 577 464 tons of sweet corn, 24,683 tons of snap beans, 38,003 tons of asparagus, 41,654 tons of cucumbers, 12,100,055 crates of lettuce,, 21,835,000 bushels of onions 26,354,140 bushels of early white potatoes, 183,272 tons of peas, 2,422,000 crates of cauliflower, 1,022,258 tons of tomatoes, and 8,660,773 crates of celery

From our orchards we obtained 43,697,000 bushels of peaches, 17,279,000 bushels of pears, 27,200,000 boxes of oranges, and 240,412,000 bushels of apples. The cranberry harvest netted 431,000 barrels, our melon patches yielded 11,652,356 crates of cantaloupes and watermelons to the number of 49,577,000, while our strawberry beds produced 4,590,700 crates. As all of us know there are other fruits and berries which play a more or less conspicuous part in our dietary, but space forbids detailed statistics.

With one exception, the people of the United States are the largest meat eaters in the world, and something like 22 per cent of their income is spent for this commodity Therefore, in order to appreciate the magnitude of the industry devoted to gratifying this taste, let us see what our farmers and ranchmen produce to meet this demand In 1920 our edible livestock was made up in the main of 23,321,000 milch cows, 42 870,000 other cattle, 45,067,000 sheep, and substantially 66,650 000 swine During the year in question our abattoirs slaughtered more than 100,000,000 animals, and the dressed meat, including lard, amounted to quite 20,500,000,000 pounds. That is to say, there was placed on the market meat enough to supply everyone of us with 195 pounds, or about 8.5 pounds more per capita than the consumption

For several years we have been eating less meat than previously and substituting larger quantities of other foodstuffs instead That is to say, where our diet was formerly composed of about two-thirds meat and one-third cereals we are adding more of the latter to our fare and drinking larger measures of milk The dietitians tell us that the change is better both for our bodies and for our purses. Striking a national average, each of us does away annually with 6.4 pounds of lamb and mutton, 80 pounds of beef and veal, and 100 1 pounds of pork In this connection it is interesting to point out that the urban dweller consumes more beef and sheep products than his brother in the rural districts, while the latter eats more bountifully of pork,

Of marked economic importance is the prevailing tendency of the American public to eat more lamb per capita than is the case in any other country, while mutton is less and less called for by the people. This situation has been brought about by a realization that the sheep is quite as important as a source of meat as it is as a producer of wool, and the consumer prefers today the delicately flavored lamb to the stronger-tasting mutton. In the East, one pound of mutton and lamb is used for every five pounds of beef, in the South the ratio is one to ten, in the West it is one to twelve, and in the Central States it is one to twenty

A quarter of a century ago there was virtually no difference between the market value, per hundred pounds, of a matured wether or a young lamb, and for that reason the sheep man held his stock a few years for the purpose of getting several clips of wool and then disposing of his old sheep at a fair price. However, a great many of these mature animals died of old age and never reached the market. Now, lamb commands not only a better price than mutton, and is more widely eaten here, but the augmented flocks furnish us with amplified stocks of wool At the present time fully 75 per cent of the receipts at killing centers consists of lambs and yearlings and about 5 per cent of matured wethers—the remainder being old ewes and rams.

It has been said that the United States produces in the course of a twelvemonth enough poultry and eggs to buy the cotton and tobacco crops of the country for that period Astonishing as this statement may seem, a little analysis reveals that it is correct. In 1920, the farm value of the tobacco grown was $318,359,000, and that of cotton reached $914,590,000—a total of $1,232,949,000 From our hen houses we garner annually now 2,500,000,000 dozen eggs, in round numbers, and our production of poultry during a like interval is in the neighborhood of 1,700,000,000 pounds. Taking the yearly mean prices for eggs and poultry, the farmers got in 1920 substantially $1,075,000,000 for these foodstuffs, bearing out the comparison quoted.

Coming down to dairy products, our citizenry are unusually favored. Despite the fact that our average cow gives in the course of a twelvemonth less than 4,000 pounds of milk, the total yield for 1920 was approximately 90,000,000,000 pounds or 10,400,000,000 gallons. From this we made 1,600,000,000 pounds of butter, 400,000,000 pounds of cheese, 1,578,000,000 pounds of condensed milk, more than 85,000,000 pounds of powdered, malted and sterilized milk, not to mention 260,000,000 gallons of ice cream, leaving then enough milk to enter into the manufacture of 370,000,000 pounds of oleomargarine and to provide fluid milk for household purposes to the measure of 48 gallons per capita annually It is rather significant that our production of oleomargarine has increased more rapidly than our population The per capita consumption of this foodstuff was only a little more than half a pound here in 1905, while at the present time it exceeds three and a half pounds.

From our waters, salt and fresh, we obtain yearly 2,400,000,000 pounds of fish, and about 72 per cent of this catch is taken from along the Atlantic seaboard. As a people we are not notable fish eaters—the yearly consumption per person being about 18 pounds as against 65 pounds in England. However, it is safe to say that nowhere else in the world can people remote from the sources of supply enjoy the variety and abundance of fresh seafood such as are available to our citizens hundreds, yes thousands, of miles inland. It may not be commonly known that 90 per cent of all of the fresh halibut eaten by us is caught off the coast of Alaska and delivered thence to all sections of the country. Similarly, most of the fresh salmon served us is moved long distances to gratify our palates. This matter of handling fish logically brings us to two prime phases of the question of our food supply—*i.e.*, the modern methods employed to preserve perishable comestibles and to effect their distribution under circumstances that will insure their fitness for consumption.

The cold storage warehouse and the refrigerator car have revolutionized the American dietary and have made it practicable to spread the fruits of the seasons of plenty over the months of normal scarcity; to sta-

bilize the agricultural industry over the entire year, and to neutralize climatic conditions so far as to enable the produce of warm or favored sections to be dispatched to those not so smiled upon by Nature. By reason of these facilities the American enjoys the year round a fuller, a better and a more diversified fare than his foreign fellow anywhere. Further, these same agencies encourage the utmost use of our arable acres through the assurance that a greater measure of their output will sooner or later reach a profitable market.

How, but for the cold storage warehouse and the refrigerator car, would it be feasible for us to put away during the spring and summer immense quantities of new-laid eggs, freshly made butter, poultry, fruits and vegetables, etc., and then send them broadcast later on so that the mild months, in a food sense, can overlap or ameliorate the harsh conditions of the periods of cold? We are authoritatively told that eggs laid in April and placed promptly in cold storage are apt to be better than the rival fresh commodity that is sent direct from the nests to the market during August. Similarly, butter made from cream produced by cows feeding upon the succulent grass of the spring and early summer is sweeter and of finer flavor, even after months in cold storage, than butter churned later on in the year. The essential thing is that the perishable commodity, be that what it may, shall be in prime condition before it is put in storage, for this method of preservation can only arrest deterioration. Butter of an inferior quality will suffer more in storage than good butter; and the U. S. Department of Agriculture has held butter in cold storage for three years—the grade then being such as to warrant its scoring 92 out of a possible 100 in order of merit. However, for economic reasons, butter is usually less than a year old when it leaves the freezer for the market.

The length of time that eggs can be retained in a properly operated cold storage plant depends mainly on their state when they enter. Eggs laid during cool weather keep best and longest. Therefore, the March and April pack of eggs is held for midwinter use, while the June pack is usually disposed of during the late autumn and early winter, when seasonal production first begins to decrease. If the spring eggs have been carefully graded and packed before going into storage, they can be served poached or soft boiled and will be found palatable up to six months old, and they are still good for food at the end of nine months when prepared or used in other ways. At no time does the number of eggs in storage exceed 10 per cent of the annual production, while in the case of butter the quantity stored for subsequent distribution does not amount to more than 7 per cent.

Latterly, the frozen-egg industry has increased rapidly. Twelve years ago the eggs that are now frozen were practically a loss, because they either had cracked shells or were otherwise unfit for storage. The practice is to break these eggs into buckets or containers and then to freeze them. In this form they are sold extensively to bakers and confectioners, and thus an annual loss of $50,000,000 is avoided. The public is the gainer by reason of the greater quantities of cake, pies, and candy at its disposal, while there is a larger supply of perfect eggs for different purposes. For the sake of those unfamiliar with the subject, eggs in the shell are carried at a temperature low enough to preserve them but high enough to prevent freezing.

According to the requirements of the season and the market, foodstuffs are pre-cooled or frozen, and generally speaking the first process is applied to commodities that are to be held for a short while—ranging from days to a few weeks, whereas freezing is resorted to to insure keeping over a period of months. Fish in the frozen state have been so preserved experimentally for 27 months without showing any chemical change or material loss in palatability. Our annual frozen fish pack is, however, usually distributed within ten months.

According to the Federal authorities, we have 1887 cold storage establishments, representing an aggregate storage space of 463,025,218 cubic feet. Depending upon the nature of the business done by these concerns the temperatures range from 10 degrees below zero to 45 degrees above. In fact, the term cold storage, as legally defined, means the storage or keeping of any article of food at or below the temperature of 45 degrees above zero Fahrenheit. Some plants have at their disposal quite 5,000,000 cubic feet of space; and it seems that these conservation facilities do not at any time contain more than 10 per cent or 12 per cent of the meat supply of the nation. This indicates that they are used in a way that serves to stabilize both the agricultural and the fishing industries and that tends to steady prices against extreme variations.

Our citizenry as a whole, however, could not enjoy the bounty they now do if dependence were placed alone upon cold storage warehouses. The refrigerator car has become an indispensable link between these reservoirs of comestibles and our widely scattered consumers. Refrigerator cars—and there are thousands of them in use—widen the effective radius of cold-storage service, whether they be employed in the transportation of chilled or frozen commodities.

Other mediums by which seasonal abundance can be conserved for later consumption are our great grain elevators and our canning, drying, and preserving industries, and through these agencies a steadily increasing percentage of each crop reaches our tables from year to year. Both Federal and State authorities are doing their utmost to improve and to amplify our herds, our grains, our vegetables, our fruits, etc., and to develop those species and varieties which will flourish best in the different sections of the country suited to their propagation. Thus, in the main, the United States is able to load her market basket and to provide from domestic resources food enough for her people, but, even so, we do face a vital problem that sooner or later must be solved.

One hundred years ago out of all of the persons employed in American occupations 87.1 per cent were engaged in agriculture. A half century later the tillers of our soil represented only 47.5 per cent of our workers, and the U. S. Department of Agriculture, touching upon this point, has declared that it would not be surprised if the complete returns for 1920 showed that only 30 per cent of our industrial army are farmers. Whether this state of affairs will be offset by improved agricultural machinery, the wider use of the farm tractor, and greater reliance upon motor trucks for the speedy delivery of produce to shipping or distributing points, is a matter of speculation. Certain it is, in view of what is done abroad in some countries, that we can get larger yields per acre of several staple crops than we now do. This can be achieved by closer adherence to the scientific cultivation of the soil—putting into daily practice the lessons learned at our numerous Agricultural Experimental Stations. Nature has been generous to us, and America need never feel the pinch of want, never be short of food, if her husbandmen make the most of her available acres and diversified climate.

The Motor Tanker "Conde de Churruca"

A TWIN SCREW oil tanker recently launched at the works of Sir W. G. Armstrong, Whitworth and Company, is described in *The Engineer*, Sept. 16, 1921. It is propelled by two 1250-brake-horsepower Armstrong Sulzer engines, representing the most recent type of design and also being the largest engines of this type which have up to the present been fitted in a British mercantile vessel. The deck machinery, consisting of the anchor windlass, winches, and derricks, is all steam driven, the steam being raised in an oil-fired donkey boiler which also provides steam for the heating coils in the cargo and fuel tanks.

The engines develop each 1250 brake-horsepower at 100 revolutions per minute in four cylinders of 600-millimeter bore and 900-millimeter stroke. They are equipped with a rotary sleeve valve which controls the admission of scavenging air to the cylinder. The correct position of this valve is determined for head and astern by a simple loose eccentric worked from the operating gear.

The starting and reversing mechanisms are so interlocked that no false start can be made. During the trials it was shown that each engine could be started and stopped twelve times consecutively without replenishing the starting receivers. There are eight of these, each of 800 liters capacity. In addition to the high-pressure receivers there is a low-pressure receiver supplied through a reducing valve. This receiver provides air service for the motors for the operating gear and the turning gear and also for the air-driven lubricating-oil priming pump and the whistle.

The piston is cooled by a spray, sea water being used as the cooling medium. During the war an experiment was made to test the effect of heat stress on the delicate parts of the engine. The test engine was overheated till the exhaust pipe was heated to redness and collapsed. When the engine was opened up the piston rings were intact and the lubrication was unimpaired, owing to the efficiency of the cooling system. The piston itself is made in two sections. The crown is only about 44 millimeters thick and is supported by five buttresses of special shape which allow the piston to take up its own position when the heat stresses come on. The piston-rod is so joined to the body that the piston is free to expand radially and sticking is claimed to have been entirely eliminated.

All control mechanism is grouped on the top platform in full sight of the valve-gear and fuel-pump mechanism. This is, however, optional, and the makers are also prepared to fit auxiliary control on the lower platform. The starting valve is operated by a mechanical device, so constructed that it can be readily removed and examined. This makes it possible for the engineer to assure himself that the maneuvering gear is in good working order. Among auxiliaries attention is called to the electric steering gear and the combined compressor and generator to be used for emergency purposes. This consists of a two-stage air compressor delivering air at 1200 pounds per square inch driven by a 12-horsepower hand started hot bulb engine, which is also coupled to an 8-kilowatt 110-volt emergency generator. The two engines, built with flywheels, pumps and all fittings, weigh about 330 tons.

The Electric Field of the Atmosphere During Storms

A SWEDISH physicist named Norinder has been engaged since 1918 at Upsala making careful measurements of the variations of the electric state of the atmosphere during the course of storms. For this purpose he records by means of a very rapid instrument the differences of potential manifested between two parallel horizontal wires, whose distance from the ground is adjustable up to forty meters in height. He thus determines through the oscillations which appear in the recorded curve, the variations of the "gradient" of the potential measured between the two wires, the term "gradient of the potential" is applied to the difference of potential between two points one meter apart from each other. The diagrams obtained make it possible to distinguish two kinds of variations in the electric field during a storm—first a slow variation lasting for at least ten seconds, which appears to be connected with the movements of the clouds and with silent discharges, next there appear very rapid changes in the electric field, which are connected with the flashes of lightning which occur in the vicinity of the post, in intervals of time much shorter than one second there may be observed the variations of the gradient comprised between 30,000 and 00,000 volts per meter. Several times gradients of 100,000 volts per meter were observed and on one occasion 185,000 volts per meter, and this in observations made at a distance of about 2 km from the point where the electrical discharge was produced.

The most interesting thing about these measurements is the proof they furnish that the value of the electric field of the atmosphere during storms has hitherto been underestimated. It has been thought heretofore that the maximum gradient in the vicinity of the ground was only about 20,000 volts per meter. Norinder's experiments prove it may be much greater, and this explains many accidents on electric lines which had been thought to be sufficiently insulated. Since Norinder's observations made at several kilometers distance from the electric discharge itself show gradients as high as 100,000 volts per meter the gradient in the actual neighborhood of a "thunder bolt" may be really formidable.

Gear-Shift Innovations

ONE remarkable solution of the change-gear problem is the *Lentz Hydraulic Gear* exhibited by the constructors, Messrs. Bruschke & Bergner, of Berlin. This comprises a system of oil pumps, the primary part of which is driven immediately from the motor and, according to the actual adjustment, feeds one or several secondary pumps with compressed oil. There are no toothed wheels, the mechanism works quite smoothly and noiselessly and the wear and tear on the motor and tires is reduced to a minimum. The gear also serves as a hydraulic brake and does away with any clutch, one special type being at the same time a substitute for the differential gear otherwise indispensable.

A radical solution of the change-gear problem has been devised by Dr. Maybach by doing away entirely with this organ. In fact, Messrs. Maybach-Motorenbau, Ltd., of Friedrichshafen, have on show a *gearless motor-car*. Instead of transmitting the energy of the remarkably elastic motor to the rear wheels through the intermediary of a four-speed change-gear the jointed shaft leads immediately from the clutch to the rear-axle drive. The motor is started electrically, the starting pedal being so arranged beside the accelerator as to enable both to be acted upon simultaneously until the carburetor position most favorable for starting is reached. The starting motor is so designed as to start safely and noiselessly not only the motor, but the whole of the car. In addition to the usual braking pedal, to the right of the steering column, there is provided, in the place of the ordinary clutch pedal, a pedal actuated whenever an extraordinarily heavy gradient is to be negotiated. When pushing this "Mountain Pedal," there is readily noted an intermediary position where the motor is out of connection with the driving gear and therefore can be kept running light, whenever this, for some reason or other, is thought desirable.

The Radio Central

America's Bid for World-Wide Wireless Supremacy as Crystallized in the Huge Station at Rocky Point

By Austin C. Lescarboura

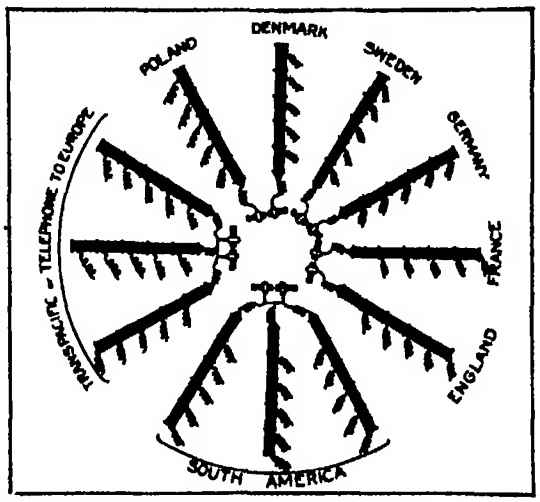
COMMERCE and rapid communication are partners. Especially is this true in long-distance commerce, which only became possible with the establishing of a universal postal service and really practical with the development of still more rapid means of communication in the form of the telegraph, cable, and wireless. Today the merchant in New York deals with his customer in China with every possible facility, for a rapid and reliable interchange of thoughts brings these parties within what veritably amounts to speaking distance. The more detailed matters are handled by correspondence, to be sure but there is urgent need for the faster arteries of communication now available even to the remotest corners of the earth.

General view of the Central Traffic Office of the Radio Central. These operators receive and transmit *radiograms through the receiving and transmitting stations many miles away*

Until now we Americans have been pretty well satisfied to do business among ourselves, with little thought and attention paid to the outside world. Such export trade as we did handle was largely unsolicited. But now that the world has turned a new corner and we find ourselves obliged to take a hand in international trade, there is little doubt but that we plan to play this game just as strenuously and thoroughly as anything else in which we have yet engaged.

The first step is to establish rapid and reliable means of communication with the leading countries of the world. Not satisfied with the vast network of cables, we are going ahead with a vast system of wireless which will place us in direct touch with our friends in Europe and our neighbors to the south. Our plans, which are well along toward realization, are to make New York City the focal point of wireless or radio traffic, just as Great Britain has long been the center of a large network of cables.

These plans find expression in the huge Radio Central which is now in operation to the extent of one-sixth of its ultimate capacity. With the foregoing facts as a background on which to estimate the value of this gigantic enterprise and the pressing need for its services, a description of this largest and latest of wireless stations is of more than passing interest.



Diagrammatic layout of the aerial system of Radio Central, indicating the separate aerials, towers, helix units and alternators

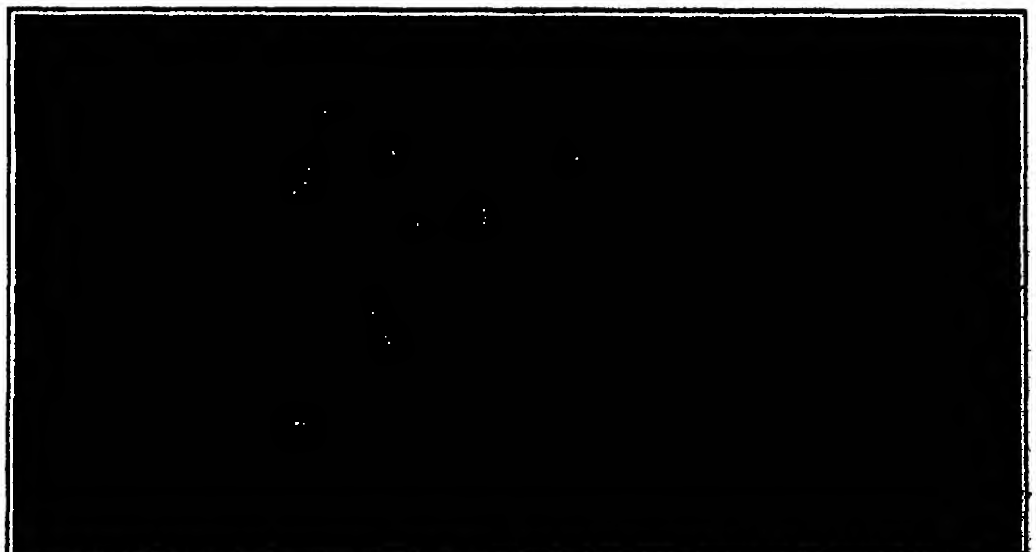
Radio Central is, as its name implies, a group of wireless stations that have been centralized for the purpose of more ready handling. Radio Central is located at Rocky Point, Long Island, about seventy miles east of New York City. Yet the actual operation of this station takes place in an office on Broad Street, in the very heart of New York's financial district. It is quite likely that the operators who send and receive the dispatches through Radio Central may never see the transmitters with which they work over a direct land line, while the attendants at Rocky Point may understand little and care less of the dots and dashes flashed out by their equipment.

A description of Radio Central appeared in these columns at the time it was first conceived. That was about a year and a half ago. The plans call for twelve aerials, arranged as the spokes of a wheel radiating from a center in which is located the transmitting station proper. Each spoke of the wheel or single aerial comprises six steel towers, so that there are seventy-two steel towers in all. Each spoke is 1¼ miles long, or three miles for the diameter of the wheel or circle circumscribing the towers and the aerials. The station site covers 6400 acres, or about ten square miles.

At the present writing the first twelve towers have been erected and the two aerials which they support are in operation. The construction of Radio Central began July, 1920, and the first test signals were sent in October, 1921, or a little more than a year from the time work was started. On November 5th the first unit of Radio Central was officially thrown open to the public with elaborate ceremonies, the principal feature of which was the broadcasting of a message by President Harding. The President, pressing a button in the White House, set to work an automatic transmitter which sent his message over land line to Rocky Point, where it was automatically relayed to the Alexanderson high frequency alternator and dispatched to the most distant points in the form of radio waves.

Each steel tower of Radio Central is 410 feet high, while the cross-arm or bridge supporting the aerial wires at the top measures 150 feet from tip to tip. In all, 1800 tons of structural steel were used to erect the first twelve towers, each tower requiring approximately 150 tons. Furthermore, 8200 tons of concrete was employed for the foundations of the twelve towers, the base of each tower leg being sunk nine feet below the surface of the ground. The distance between two adjacent towers is 1250 feet. Curiously enough, one fails to be convinced of the magnitude of these towers, for the good and sufficient reason that they stand more or less alone in a wilderness of shrub oaks and small bushes, so that there is no ready means of drawing a comparison as to size. In fact, many visitors to the station on the opening day stepped from the special train with the firm belief that the station was but a short distance away. The steel towers appeared to be a quarter of a mile away, perhaps a little farther, but certainly within easy walking distance. Yet to their keen disappointment these same visitors who had set out on foot discovered that Radio Central was several miles distant, and that the towers are highly deceptive both in size and in intervening distance. They may be seen for many miles across the slightly rolling country of that part of Long Island.

Each aerial consists of sixteen silicon bronze cables three-eighths inch in diameter, stretched horizontally from tower to tower. In all, fifty miles of this cable has been used for the two aerial systems already completed. On the other hand, the ground system for both aerials consists of 450 miles of copper wire buried in the ground under the entire aerial system in starfish and gridiron pattern. At regular intervals the aerial is connected to the ground through a huge outdoor helix in accordance with the multiple-tuned aerial practice developed by the Radio Corporation of American engineers. Each of these helix or inductance units is several times larger than a man, and altogether add greatly to the complexity of the Radio Central installation.



Arrangement of the receiving apparatus at the Riverhead station. Note how the various units for tuning, detecting, and amplifying are arranged. The engineer is shown adjusting a receiving unit for the receiving operator in New York City

So much for the aerial system, which forms such an important part of any radio station. The first power-house section which, as already stated, is located in the center of the aerial system, covers a space of 150 feet by 60 feet and accommodates two 200-kilowatt Alexanderson high-frequency transmitting alternators with auxiliaries and equipment. It is a far cry from

the old crashing spark gap of earlier transatlantic stations to the quiet and businesslike Alexanderson alternator Yet this machine, which differs very little from the usual light and power generator so far as externals go, has brought about a new era in commercial radio In place of the spectacular it has wrought the practical; in place of the uncertain, troublesome and awkward spark transmitter it has introduced the almost silent, simple and convenient high frequency generator which produces current that requires few auxiliary pieces of equipment before sending it to the aerial, there to be propagated in all directions in the form of radio waves. The Alexanderson alternator also makes radio telephony a more practical thing than had been hoped for but a short while back, although it seems likely that ultimately all transmission, whether on a small or large scale, will be handled by vacuum tubes. Much remains to be done in the way of perfecting large vacuum tube units and reducing their first and upkeep costs, but the vacuum tube is obviously the ultimate radio transmitter, eliminating as it does all moving parts and elaborate accessories. However, that is another story.

Part of the transmitting apparatus at Radio Central, neatly mounted on iron framework for ready inspection and adjustment The magnetic amplifiers are placed on the floor, and the inductance units above

Now let us get this operating scheme of Radio Central clearly established First of all, each aerial amounts to a separate transmitter—a separate station, practically, serving as the artery of radio communication with a single overseas station Thus one aerial or "leg" will serve as the transmitter to France, another to Great Britain, another to Germany, still another to Scandinavia, and yet another to Poland South American countries will be taken care of by other aerials of the twelve that will ultimately complete the Radio Central. Each aerial is served by a single 200-kilowatt Alexanderson alternator, although it may be that for extreme distances, such as South American and trans-pacific services, two or three aerials may be used as a single transmitting unit, energized by two or more alternators.

Radio Central is divided into a transmitting station and a receiving station. Only the transmitting station has thus far been dealt with The receiving station is located at Riverhead, Long Island, some sixteen miles away from the transmitting station at Rocky Point As in the case of Rocky Point, no operators are located at Riverhead, because the distant signals are intercepted by the radio equipment and automatically transferred to wire lines and received as audible signals at the Central Traffic Office in New York City The action is practically simultaneous from the moment signals are transmitted from the overseas station and picked up at Riverhead, to the moment of actual transcribing by the receiving operators in New York

The centralized control as accomplished by the Radio Corporation's transmitting station at Radio Central and receiving station at Riverhead, as well as its other high power stations, has solved the problem of multiplex operation and made possible this practical communication service which is now at the disposal of the American business man. A sending speed of 100 words per minute is at present possible with the use of each transmitting unit at Radio Central This means a combined sending capacity of 200 words per minute for the two completed units. The transmission range of Radio Central is practically world-wide, as demonstrated by preliminary tests when the station was heard in all parts of Europe, as well as in such far-flung corners as Australia, South America and Japan.

Following the universal practice of making modern long-distance wireless stations as attractive as possible, Radio Central has received various little touches here and there which have more to do with human engineering, so to speak, than radio engineering. We have in mind the attractive Community House for the staff at the transmitting station. This is a low one-story building which bears strong resemblance to the usual country club. It contains sixteen single rooms for the unmarried members of the staff, an official suite, a large living-room and dining-room, as well as quarters for the help. Then there are several detached bungalows for the married members of the staff The personnel necessary to maintain the huge station in operation comprises the engineer in charge with a staff of fifteen assistants, for the present Ultimately, as one by one the transmitting units are added to the Radio Central, more personnel will be required, it goes without saying Another little touch which sets off the station and softens its otherwise grim aspect is the cooling pond, for cooling the water after it has circulated through the high-speed alternators. This basin of water covers a ground space of 64 by 42 feet, and is 7 feet deep. The pond is equipped with four spray heads which, when operating, present a beautiful and ornamental appearance, dressing in no little measure the entrance to the transmitting station building

Radio Central must mean the focusing of the radio systems of the world on New York City When completed its capacity and its range will be such as to bring the leading nations of the world to the very door of the American metropolis, to and from which auxiliary communication can be maintained over the usual telegraph and telephone lines, in order that the entire country may use Radio Central When completely realized, Radio Central will probably comprise ten high frequency alternators, giving a total output of 2000 kilowatts, or 2700 horsepower A mighty big bid for the world's radio supremacy, is it not?

Steel towers and aerials forming only a small part of the Radio Central aerial system. There are to be seventy-two steel towers supporting twelve separate aerials in the completed installation

Theodore G. Hoster

IT is with great regret that we are obliged to chronicle the death of Mr Theodore G. Hoster, who was associated with Messrs Munn & Co as a patent attorney for over forty years. In this connection he was known to thousands of clients who had occasion to consult him in relation to patent cases Mr Hoster was one of the best recognized experts in the United States on several lines of invention activity, and his disinterested advice was always at the service of all Although Mr Hoster was not a native of the United States, having been born in Germany in 1854 no one was more thoroughly Americanized than he He was educated at a technical school in Winnweiler and came to this country in 1871

His first activities were related to mechanical enterprises in Ohio, Florida and Mississippi, and he was at one time identified with steam navigation on the Mississippi River He finally gravitated to New York, and in 1880 he became one of the patent attorneys of Messrs Munn & Co, and for over forty years gave up his life to the prosecution of patent cases.

He numbered among his clients some of the most successful inventors which the United States has ever produced. Commissioner Moore stated that Mr Hoster had prosecuted more applications before the Patent Office than any attorney he ever knew of There is little question that Commissioner Moore is right in this statement, and thousands of his clients will be very sorry to hear of his death His associates in the patent offices of Messrs Munn & Co, and also the SCIENTIFIC AMERICAN, mourn his loss very deeply, as Mr Hoster was a man of sterling integrity and his friends were friends of a lifetime

Design of Atmospheric Burners

THE Bureau of Standards has carried on an extensive investigation of gas burner design intended primarily for the benefit of manufacturers of gas appliances and industrial gas appliance engineers.

The results of this work are given in Technologic Paper No 193 of the Bureau of Standards which is now for sale by the Superintendent of Documents, Government Printing Office, Washington, D C

In this paper no extensive presentation of the theory has been attempted the aim being rather to show by means of tables and curves based on experimental data the effect of various factors on the operation of burners With the arrangement of apparatus and method of testing that has been developed it is possible to measure quickly and accurately the volume of air injected into any burner under any condition of operation, as well as to determine the limits of operation with any quality of gas. Such information is essential in order to enable one to design burners for any predetermined condition of operation In order to understand the various factors entering into the design of burners, it was found necessary to study the theory of the flow of gas through different types of orifices, the principles governing the rate of injection of air into the burner, the design of the injecting tube, the rate of consumption of burners of different port areas, and the effect of adjustment of the air shutter These various factors are taken up in detail

In conclusion it is pointed out that on account of its simplicity, low cost, and reliability, the atmospheric gas burner is well adapted for domestic and most of the smaller industrial purposes. If it is possible to widen the range within which such burners can be operated efficiently and without adjustment and design them to meet the needs of any particular purpose, it will make gas fuel much more valuable and will broaden its field of application

With these facts in view the Bureau has been conducting experiments on atmospheric burners both with natural and artificial gas and the results will be reported in subsequent papers.

The Hydraulic Laboratory

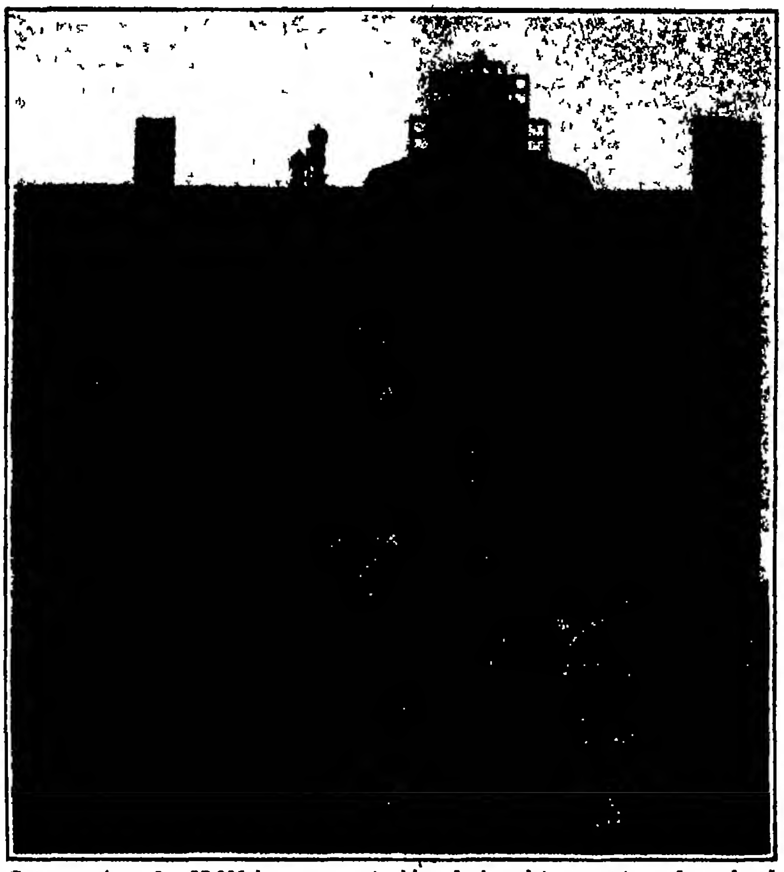
A Prime Aid in Helping Us to Make the Most of Our Waterpower Resources

By S. G. Roberts

WE have actually in service today a total of 8,200,000 horsepower which is developed by the impulse of falling waters. In the near future a number of hydroelectric projects will be taken in hand which will amplify this block of energy by approximately 2,000,000 horsepower, and to accomplish this will call for the expenditure of substantially $2,000,000,000. We are at last awake to the fact that fuel is costly and the price disturbingly variable, while Nature's running waters can be made reasonably uniform in their flow, are inexhaustible, and are free—the same volume being available for successive users provided the head remains high enough.

The public at large has an imperfect conception of the evolution that has been taking place since we began the building of hydroelectric power stations. The modern water turbine is a radically different apparatus from the water wheel which for a long time served to furnish motive energy. Thanks to the cunning coordination of practice and theory much has been done in the direction of betterment, and performances now are vastly superior to those but two decades back in this particular realm of mechanics.

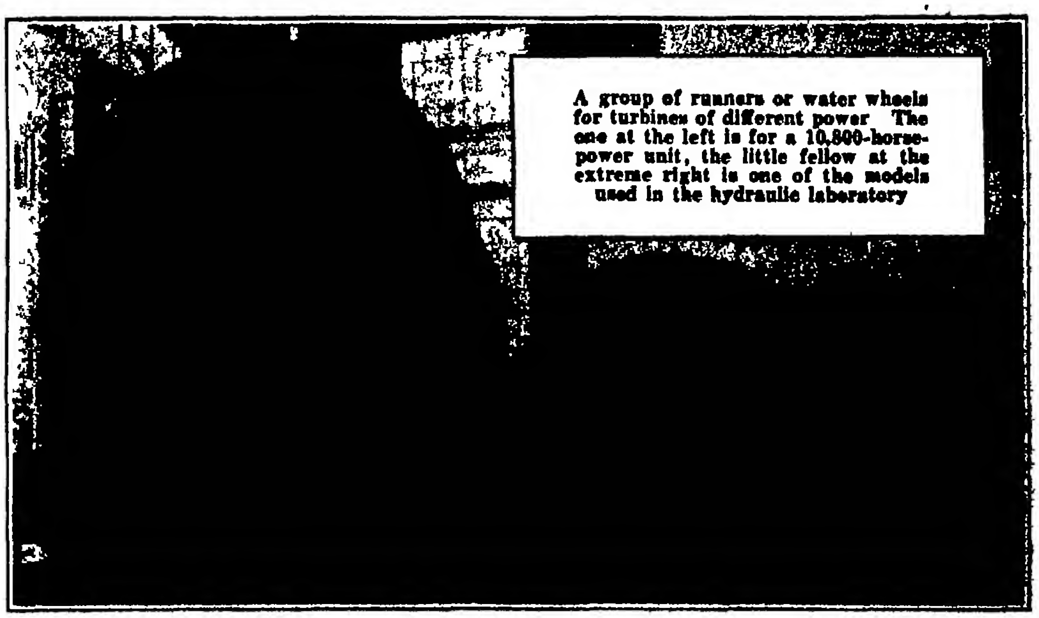
As recently as 1900 the efficiency of standard types of water turbines did not exceed 78 per cent when operating at 100 per cent of their rated power, and at half load their efficiency dropped to something like 48 per cent. Today, there are turbines at work that have an efficiency ranging from 90 to 93 per cent when turning over at speeds capable of producing anywhere from 50 to 100 per cent of their rated power. That is to say, the units are able to perform admirably when carrying only a part of their maximum designed loads. This is a matter of importance in meeting changing demands for electrical energy.



Cross-section of a 55,000-horsepower turbine designed to operate under a head of 305 feet and to run at a speed of 187.5 revolutions per minute. The generator surmounts the driving shaft. At the lower left is seen a penstock valve in position. Beneath the turbine is the recently developed spreading draft tube which exhausts into the tailrace at the extreme right

No small share of this advance in the art is due to the aid of the research laboratory where the diversified problems of the water turbine have been studied under conditions which have clarified many puzzling questions and revealed phenomena that were undreamed of or only suspected. This line of investigation has expanded from year to year, and in pace with it have been provided equipment and facilities which render it feasible to duplicate on a small but suitable scale the essential features of a complete and big commercial hydroelectric installation.

Much experimenting has been done by power companies and turbine manufacturers at the Holyoke Testing Flume, Holyoke, Massachusetts, and runners have been tried out there on a steadily increasing scale. The results, while often extremely good, were not subsequently reproduced so satisfactorily when the turbines as a whole were placed in their ultimate positions. This fact, and the additional consideration that the "waiting list" at the Holyoke Flume was generally a long one, led one of the participants in the Holyoke project to branch out, and establish its own hydraulic laboratory at Petty's Island in the Delaware River. The plant has amply compensated for the outlay, and has been instrumental in unraveling some questions and in bringing about certain notable improvements in water turbines and their associate features.



A group of runners or water wheels for turbines of different power. The one at the left is for a 10,800-horsepower unit, the little fellow at the extreme right is one of the models used in the hydraulic laboratory

The laboratory at Petty's Island has obviated the inconvenience of shipping to Holyoke the equipment required for numerous separate tests, and it has enabled the Philadelphia firm to carry out its research on complete turbines, including the turbine runner and draft tube passages leading therefrom. This has latterly been found to be of vital importance. It has for sometime been realized by hydraulic engineers that the greatest development in water turbines is likely to lie in increased specific speed of the runners or wheels, as they are popularly termed. That is to say, where a given amount of power may be generated under a fixed head of water, future success will hinge upon the ability to obtain this power by employing single-runner, direct-connected turbines making the highest possible number of revolutions per minute. Machines of this character cost less to build, permit the use of cheaper generators, and render it feasible to utilize low-head sites. These were the desiderata that induced the Philadelphia company to erect its hydraulic laboratory.

To the popular mind the impulsive force of water driving a hydraulic turbine entails nothing more complex than directing the flowing water to the wheel blades and then providing a passage by which it can escape into the tailrace and thence into a nearby stream. As a matter of fact the efficient utilization of the water's pent-up energy or momentum is nothing like so simple; and the function of the hydraulic laboratory is to enable the technicist to analyze and to evaluate the divers variables in advance of constructing the power units of hydroelectric stations.

The day was not so long ago when the turbine manufacturer had "stock" or so-called "standard" designs which he was ready to turn out on demand for any power site, and, needless to remark, some of these performed fairly well while others were decidedly indifferent in their efficiencies. The hydraulic engineer now knows that every change of head and numerous other physical circumstances exert more or less marked influences upon the characteristics of the machine which can be counted upon to function to the best advantage. In the western sections of the United States or wherever the precipitous drop of the waterway affords a high head, turbines of lower specific speed are more suitable, while in the eastern portion of the country low heads predominate, and for these turbines must be differently modeled so that they will run at higher specific speeds. In each case the components of the installation have to be altered to harmonize with the circumstances imposed by Nature and the physical laws that prevail.

To satisfy these conditions, and to live up to the guarantees which manufacturers have to make to power companies, the builders of turbines can no longer depend upon rule-of-thumb methods—they must be sure of their products, and to encourage them in this purchasers not infrequently offer tempting bonuses for every bit of increased efficiency over that called for by contract. It is no unusual thing for a premium of a thousand dollars to be paid for each per cent over and above the efficiency stipulated in the agreement, and when this applies to the several turbines in a large installation the reward is well worth every reasonable effort to win. Success soon justifies the outlay for the laboratory and the model tests.

The research work at Petty's Island, Pennsylvania, has enabled the operating company to fabricate turbine runners having an increased specific speed of about 100 per cent. In other words, painstaking investigation has enabled that firm in certain instances to offer quotations on turbines so patterned that they would run at twice the speed previously deemed practicable — thus bringing about marked initial and operative economics. It seems that high speed is a more important factor than high power in cutting down first cost, because high speed permits a reduction in the size of the turbine and the electric generator and reo-

ders it feasible to simplify the design of the turbine, especially when it is to be placed in low-head installations. Let us make this plain.

A few years back, in order to obtain reasonable generator speeds which would give the best electrical effects with a given type of dynamo, it was at times necessary to resort to multi-runner turbines—machines having as many as six runners or water-wheels on a single shaft. This called for six sets of guide vanes, interconnected operating gear, four or more bearings, and a corresponding increase in other associate features. Apart from adding greatly to the original cost and operating expense, the multiplicity of parts invited more risk of breakdown. With the development of the high-speed runner many of these complications have been avoided, and a single water-wheel, combined with vertical shaft units of relatively few parts, and these simple and rugged in getup, can now be constructed for less money and yet perform far better than their predecessors.

A concrete example of the gains derived by this advance in the art will help us to appreciate the aid rendered by the hydraulic laboratory. A certain power company in Pennsylvania equipped a plant in 1910 with five units of the two-runner, vertical shaft type. Four years later, when more power was desired, it was decided to adopt a single-runner, high speed design. The new apparatus was secured at a considerable saving in first cost and tests made after the installation showed a maximum efficiency of 93 per cent for the modern unit as compared with 83 per cent for the older two-runner turbines.

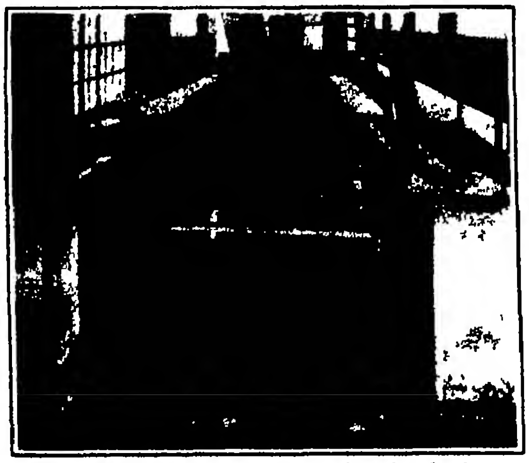
The man in the street may not grasp off hand just how essential it is for a turbine to be notably efficient. He understands, of course, that careful utilization of coal in a steam power plant is extremely desirable, for that fuel must be bought and handled. To him, on the other hand, water is in a sense free and, therefore, why bother about the measure used in developing the prescribed horsepower? The answer is: Where international streams, for instance are concerned and treaties set the exact amount of water which can be diverted from these rivers for industrial purposes, it is a matter of moment that the permissible volume shall be made to yield the largest practicable percentage of motive energy. Similarly, where water for hydro-electric stations is purchased from irrigation projects or where its use is in any way restricted there is sure to be a proportionate gain through the adoption of turbines of marked efficiency.

The hydraulic laboratory is proving a valuable aid in the evolution of water turbines of conspicuous reliability. While it is true that this factor should characterize any type of machinery still it is especially to be desired in hydroelectric plants—particularly if these be large. A shut-down for inspection or repairs involves a loss in power output which cannot be offset by any "saving in the coal pile." On the other hand there is a direct sacrifice in revenue. Suppose, for example, that the station is equipped with 30,000 horse-power units, and that the sales price of energy is at the rate of $15 per horse-power year. If one of these units were out of commission for twenty four hours it would represent a loss in income of $1,200! Accordingly, much is to be gained through strength and ruggedness of design and the adoption of a model of such simplicity that it will facilitate rapid dismantling, repairing, and reassembling when necessary.

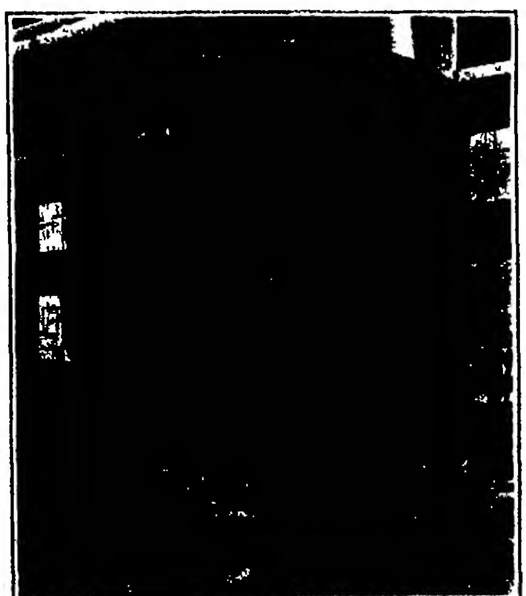
The draft tube of a turbine installation is the passage through which the water on leaving the runner makes its way to the tailrace, and this conduit plays an important part in the turbine's effective utilization of the pent-up energy in the impulse water. Much study has been given to this feature, and at the Petty's Island laboratory there has been perfected what is known as the Moody spreading draft-tube. This tube is a great advance in the art, and is an indispensable feature wherever turbine runners of high speed are employed. By means of it it is possible to increase the vacuum just below the turbine runner, and in this way to regain, in effect, a large per cent of the energy in the water which would otherwise be lost after leaving the wheel.

View of the recording station showing the dynamometer and scales for measuring the power developed by the model turbines, and the speed counter

As a reflex of the turbine investigations at the Petty's Island laboratory there has been developed the so-called Moody spiral pump. This pump marks the same progress in this particular field that is exemplified by the evolution of the high speed turbine runners and the improved pump admits of the use of electric motors that can be run at twice the velocity permissible before. As a consequence, complete pumping outfits can be manufactured and installed at greatly reduced expense. This is very desirable where large quantities of water are to be pumped under low heads. Previously it was necessary to provide rather costly low speed electrical equipment.



The water passing over the weir. In the background can be seen the stilling racks for ironing out ripples and surges, so that the water shall run smoothly and quietly over the weir



Penstock valve for a 55,000-horsepower turbine. Valves of this sort are employed to regulate the volume of water passing on to the turbine

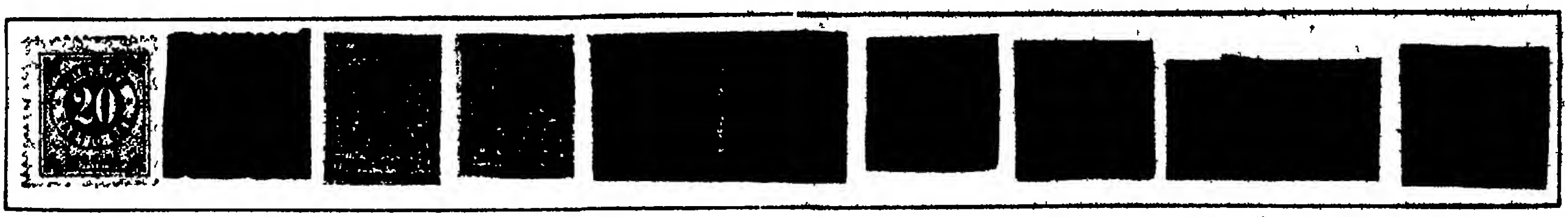
The laboratory on Petty's Island has a concrete headrace, tailrace, and return tanks. The water is lifted by means of motor-driven centrifugal pumps into the headrace tank, where the model turbine to be tested is placed. Model runners 16 inches in diameter may be tried out under heads up to 12 feet and in conjunction with various types of intakes, castings, and draft tubes. The water, after it has gone through the turbine, the draft tube, and into the tailrace, next flows into the tailrace tank and then over a weir where it is carefully measured by the volumetric method. From the weir it passes back by the return tank to the suction of the pumps. This completes the cycle. The effective head on the turbine under test is registered by differential gages attached to the headrace and the tailrace tanks, and the power developed is indicated by an Alden dynamometer upon direct reading scales.

All readings are taken simultaneously at half minute intervals agreeably to a signal bell controlled by a master clock. In this laboratory it has been found practicable to make comparative tests of the same runner or turbine when associated with different forms of draft tubes, all other conditions being the same, and by this means to arrive at an exact comparison of the effective value of the various types of draft tubes used. It was in this way that the 10-per-cent increased efficiency of the Moody design was indisputably established.

It is out of the question to discuss the numerous other factors that affect the working of a hydraulic turbine and which are studied at the laboratory in order that the force of falling water can be converted into mechanical power and then into electrical energy for transmission near and far. But it is well to emphasize that the steam turbine is no more highly specialized in its technical requirements than the water turbine. Finally, it should be kept in mind that the hydraulic engineer is today employing heads of water ranging from 10 feet or so up to 680 feet in water-power plants built or building in this country, and he is cunningly controlling these columns of water in operating turbines varying from a few hundred to 55,000 horsepower per unit. These installations would not be feasible, safe, efficient, and dependable but for the revelations and the momentous aid of the laboratory.

The Effects of Thirst

INVESTIGATING the effects of thirst on young albino rats, Tokujasu Kudo, of the Institute of Anatomy, University of Minnesota, finds in the *Journal of Experimental Zoology* for July, 1921, that albino rats about one month old may be held at constant body weight for several weeks by restricted amounts of liquid (milk) in a diet otherwise adequate for growth. The rats show a progressive tolerance of thirst, so that less liquid milk is daily required for maintenance as the experiment proceeds. The tail becomes elongated while the body length remains constant. There is in general a marked increase in weight of the skeleton and a slight increase in the visceral group. The musculature remains nearly constant in weight. There is a slight decrease in the integument and a marked loss in the "reminder." Of the individual viscera, the hypophysis, eyeballs, kidneys, suprarenals, spinal cord, skeleton, sciatic nerves, pancreas, stomach intestines, liver, and uterus show a definite increase in weight. The heart, brain, and lungs remain nearly constant in weight. The thymus, ovaries, parotid and submaxillary glands, spleen, testes, epididymides, and thyroid suffer more or less well marked decrease in weight. The growth tendencies of the various organs in the young rats during the thirst experiments correspond in general to those found in rats of similar age during under feeding, although certain exceptions occur (testes and kidneys). Likewise, the results of the thirst tests (also those of the inanition experiments) show a general resemblance to those of similar character in adults. There are certain differences according to age, however, as well as according to the type of inanition employed.



The Sweden error, the figures reading "20" and the inscription in words "thirty;" one of the very finest of counterfeits in mere reproduction of the design. A genuine Baden local stamp, worth at least a nickel unused and transformed into a $100 variety by the addition of a false postmark. The first two stamps of Reunion, of which only a few genuine copies exist. "Tete beche" pair of the one-franc French stamp of 1849, caused by inserting one electro in the block upside down. Two stamps of Naples, used provisionally for a short time during the stirring days of 1869. The "double Geneva," one of the earliest Swiss stamps. One of the first issue of Moldavia, predecessor of Roumania.

A group of counterfeits of standard rarities, which would be worth something like $5000 if they were genuine

Stamp Frauds and Their Detection

Some of the Means Adopted to Protect the Collector from Forgeries

By the Philatelic Member of the Staff

THE bulk of the stamps which the non-collector sees have no intrinsic value. They retail for a cent or two apiece, but this merely covers the cost of handling them. There are perhaps 25,000 varieties from all over the world that have a true market value based on rarity and demand. Those costing less than a dollar are apt to be neglected as trash, and as we approach the hundred-dollar class the market is, of course, limited. Nevertheless the real rarities, of which the known copies are numbered, come as high as five and ten thousand dollars, with plenty of buyers to absorb the limited offerings.

With such values and a free market, fraud is bound to be attempted. Most counterfeits are made of whole cloth. But whether the design be reproduced with the aid of a camera or by hand-engraving, it will not correspond exactly with the original. With hand-engraved counterfeits, the expert examines the details of the stamp for points of divergence from the known genuine design. The photographic reproduction is more faithful in these matters, but usually differs from its original in the general effect of tone and shading, and often in size.

The expert has seen a number of counterfeits of any given stamp, and often has a reference collection containing many of these. If the specimen under examination fails to identify itself with any familiar counterfeit it must either identify itself with the genuine stamp or display divergence that marks it as a "new" counterfeit. The examination is conducted under a glass that magnifies two or three diameters. The experienced philatelist knows what sort of mistake the counterfeiter most easily makes, and what sort he can himself best see, so he knows just about what to look for and what parts of the specimen to examine most carefully. His work is quickly completed, especially when carried on in the presence of a genuine copy.

There are numerous exceptions to this statement. Many stamps of the '40s and '50s were printed in sheets of forty or thereabouts, each "cliché" being separately type-set or engraved by hand instead of impressed or electrotyped from a single original die as is done today. The various stamps on the sheet are then no more identical than an original and 39 counterfeits. The expert now has to decide, not whether the questioned specimen is like a single original, but whether it is identical with any one of a large number of originals. This multiplies enormously the difficulty of finding material for comparison. It usually means that complete material can be had only in the form of a photograph of a reconstructed plate, which is, of course, not an absolutely faithful standard. And it means that portions of originals or suspected copies that are veiled by cancellations can not be directly compared.

This makes contributory testimony from other quarters of value. A rare stamp is rare because there are not many of them, and while early inks were not constant, it is easy to establish that certain shades are right and others not. Again, one of the most dangerous counterfeits known, so far as surface externals go (the famous Sweden error illustrated), is printed on a paper totally unlike that of the original stamp, in color, texture and thickness. Paper and color, seldom used as an absolute test, are of great value in attracting suspicion to a counterfeit of good surface appearance, and again in helping to swing the verdict in a doubtful case.

Then there is the watermark which appears on many stamps. This is a thin spot in the paper, introduced during manufacture, which transmits more light than the rest of the stamp and is visible under conditions bringing out this property. The faker can print an imitation watermark on the back in greasy ink, or he can scrape out a thin place of the desired pattern. Neither of these expedients defies detection for a minute, however, so of late years another and a better trick has been introduced.

By chemical process the design is washed off a common stamp of the same size and the same watermark as the one it is desired to imitate. One faker made a bad guess and printed an excellent forgery on paper got by cleaning a stamp with much too fine a perforation. But barring some such *faux pas*, paper thus secured is bound to be right. When the trick was new, many such fakes passed a hasty inspection on the ground that the watermark was so obviously good that the stamp *must* be right. Now the watermark is merely contributory evidence.

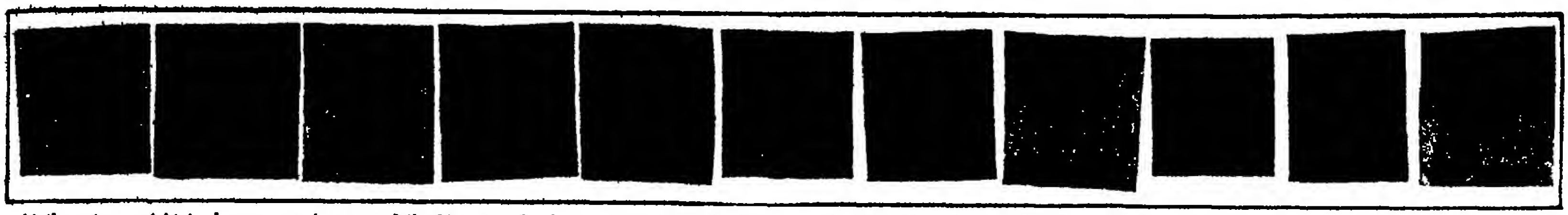
Philately's most interesting—and most puzzling—derelicts are the stamps that are partly genuine and partly false. This apparent anomaly may arise in various ways. When an entire series appears in identical design, the labels of value alone differing, the value may be erased from the commoner stamps of the set and a substitute painted or printed in, converting the stamp into a rarity. Such work is done with amazing skill, and its greatest menace lies in the fact that the general appearance of the altered stamp is altogether that of a genuine copy.

Then there are surcharged stamps. The desire to use up old and obsolete issues, the sudden necessity for stamps that have not been delivered, governmental changes, and numerous other circumstances, give rise to stamps which bear an overprint, in ordinary type, of a new value, a validating word of some sort, etc., etc. Perhaps one-tenth of all collectible varieties are of this character, and usually the overprinted stamp is valuable out of all proportion to its worth in unsurcharged condition.

This is the faker's paradise. When the false overprint is hand-stamped detection is, of course, easy. When a press is used, with studied care in duplicating the type of the genuine surcharge, an almost microscopic measurement of the surcharge is usually neces-

Left: Showing the use of the benzene cup to bring the watermark to visibility. *Right:* The perforation gage: the specimen is slid along the card until the diverging lines just coincide with successive teeth, and the gage of the perforation is then read off the side of the card. *Above:* The philatelist surrounded by his tools: magnifying glasses (one of larger power and smaller field than the other), dividers, benzene cup and supply of benzene, and tongs with which the stamp is being handled

Some of the tools of the stamp collector, and the manner of their use



At the extreme right is shown a genuine copy of the 10-centesimi value. The other ten specimens are counterfeits of various denominations of the same series, all of them being different, as a careful study of the inscriptions and frames will show Presumably the entire series exists in each style of fake since changing the numeral for the several printings would be simple enough

Ten different counterfeits of the same thing, and an original. ***The stamps are of Parma, one of the Italian duchies before the unification***

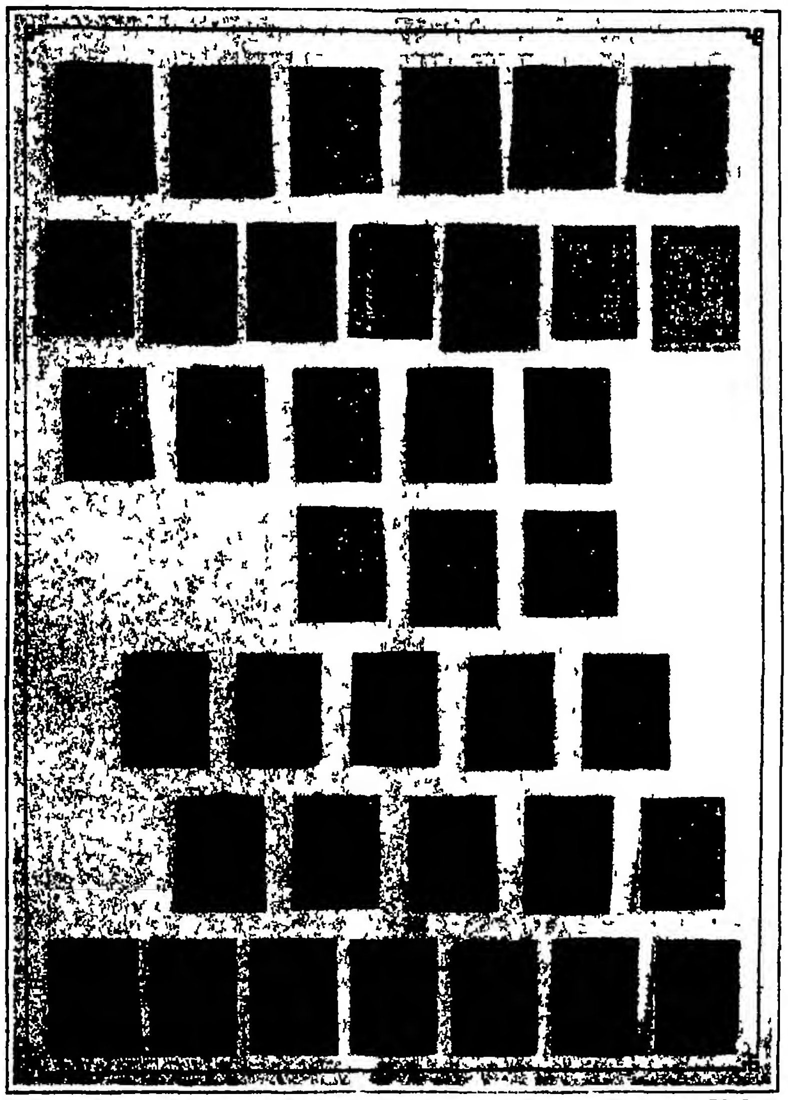
sary If a variety of little value exists presenting the same overprint on a different base, one of these is cut in two through the surcharge and we have an automatic scale against which to measure the suspected copy When this is not possible, measurements must be transferred from genuine to questioned overprint by meticulous use of the dividers. Less frequently the ink or the tone of the impression betrays the fraud. And sometimes the expert is blessed with pure luck If, for instance, a French stamp overprinted for use in Madagascar appears with a beautiful Paris cancellation, examination need go no further

An interesting development of recent years is a series of counterfeits, including several thousands of varieties, put out in Switzerland. The surcharged members of this family do not appear on genuine stamps. The entire piece—stamp, cancellation and surcharge—is forged. This, however, is exceptional, the average faker puts out his fraudulent overprints on genuine stamps.

In rare cases the unsurcharged stamp is the rare variety, the counterfeiter's task is then the removal of the offending overprint. A similar situation exists with reference to numerous British colonial stamps which were available for revenue duty, and when so used bear pen-stroke obliterations. In this condition they are practically without value, so the pen mark is removed, and gum or a "phony" cancellation applied to create an unused or a postally used copy When viewed at a very slight angle, almost parallel with the surface, these items always show the depression from which the mark has been removed. Moreover, original gum and substituted gum are two entirely different things.

Most fakes—especially those which bear a mark that it is desired to conceal—are of used stamps. One reason we have this instant suggested. Another is the present preference of most collectors for used specimens. Likewise, many collectors take a cancellation to be, within limits, an indication of genuineness. Again, in many cases unused "remainders" sold after demonetization by the post office are available for almost nothing, while cancelled copies can be manufactured from these which, if genuine, would be worth dollars, and in extreme cases hundreds of dollars. Finally, the cult of the used stamp has gone of late years to the length of collecting many special cancellations for their own sakes alone. The presence of such a postmark may raise the value of a stamp from a few cents to ten or twenty dollars—far more than the cost of unused copies. The close study of cancellations which results from this tendency, the exact knowledge of what obliterations were used and where, defeats the faker in his efforts to apply false cancellations, and when he tries to imitate the cancellation for its own sake Occasionally it even aids in the detection of ordinary counterfeits to which "cancellations" have been applied to promote salability

An amusing case recently occurred in connection with a large consignment of stamps sent here from Germany The lot included a certain Providence local stamp on original cover Unused, the stamp is worth a couple of dollars, while a genuine cover would be worth whatever you want to pay for it—surely a couple of hundred, and maybe more. Under the scrutiny of American experts it developed (1) that the pen-mark appearing on the stamp in addition to the postmarks—in this case a rather favorable bit of atmosphere—was made with a steel pen and not with the quill of 1846, (2) that the postmark showing a numeral "5" in a circle should have lacked the circle, (3) that the "5" should have been Roman rather than Italic (4) that the Providence postmark was dated three months *after the stamp ceased to be available for* postage Aside from these trifling discrepancies, the cover was entirely genuine!

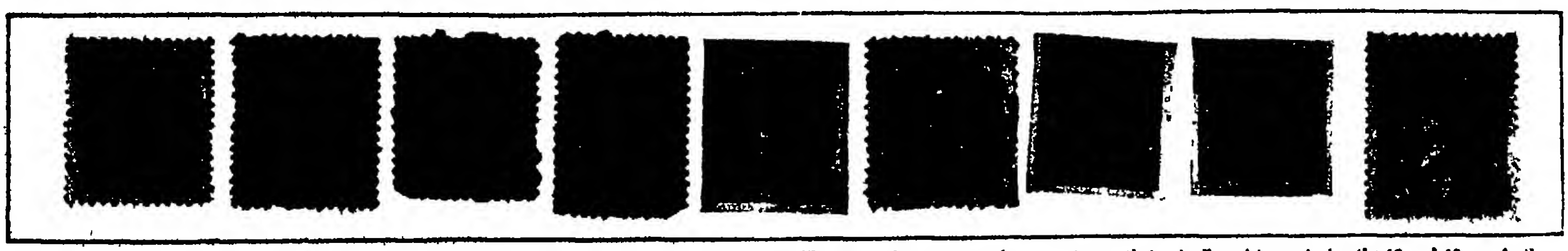


A page of early Hawaiians from a reference collection of counterfeits. If they were genuine, their value would be in the neighborhood of $13,000

Among the actual tools of the philatelist scales and dividers and magnifying glass have been mentioned Perforation gages are the most distinctive philatelic specialty The size of the perforation frequently distinguishes between two varieties of the same stamp, and is of value in discriminating between genuine and counterfeit as well The perforation is named according to the number of holes that appear in a space of two centimeters. Counting holes along the edges of many stamps becomes laborious, so gages which enable the perforation to be mechanically fitted against measuring lines or dots are substituted for counting

But after all the philatelist's chief tool is the benzene cup The stamp ordinarily quite opaque becomes semi transparent when wet with this liquid The stamp is somewhat transparent against the light when dry so here the difference is not pronounced But if we lay the dry stamp down on a black surface, what light passes through is completely absorbed by the black pigment If however we then pour benzene over it more light passes, and is now reflected back through the stamp from the film of benzene beneath it This twice-transmitted light gives a remarkable picture of the internal condition of the paper Watermarks, which are ordinarily difficult to pick out when held against the light by reason of the confusion created by the design of the stamp showing through, show up like a sore thumb in benzene Also though the story is too long to tell here, the benzene cup gives the most satisfactory guard against the wiles of the stamp repairer Modern philately makes a distinction between fine condition and poor which was unknown a generation ago, and has little use for a damaged specimen The things that a skilled repair man with a bit of the artistic temperament can do to a soiled, crumpled creased torn, and thin-spotted wreck of a valuable stamp are almost past belief But the consistency and the thickness of a repaired stamp are ordinarily sufficiently non uniform to show up in the benzene

The counterfeits used to illustrate this article are from the reference collection of Mr Percy G Doane, whose kindness in loaning them for the purpose we take this opportunity of acknowledging.



The first six items show counterfeit surcharges on genuine stamps. The inverted "2" is noteworthy. The 1, 2 and 5 centavo values are stamps that actually exist genuinely; the 12 and 18 are further values added to the set by the faker's imagination. The two Post-Office Mauritius stamps are probably the best known of the standard rarities: there are about ten of each value known to exist, and a fair price for the pair in fine condition would be $15,000 or more. Beside them is shown the cheapest counterfeit in the collection from which the pictures were made The Uruguay stamp which it imitates is worth three cents in genuine copies. Of such counterfeits thousands may with good fortune, be sold before it occurs to any buyer to examine them for genuineness

A final array of album weeds of more than ordinary interest

Comets That Have Lost Their Tails

Curious Irregularities Revealed by the Camera in These Attenuated Streamers

By J. F. Springer

Halley's comet, June 6, 1910, showing the discarded portion of the tail drifting away

AMONG the most notable of the objects to be seen in the sky are the visitors known as comets. I speak of them as "visitors," but this is only relatively correct. These bodies surely have their habitat in the surrounding universe and there is no very substantial reason to suppose they are able to get out of range of the gravitational spheres of the great mass of the visible and invisible stars. Comets come into visibility for the inhabitants of the earth and pass out of it again. They come into view suddenly and without announcement. And they never remain. So after all, there is some justice in the term *visitors*.

Some comets, however, return with more or less regularity. Perhaps, the most notable example of a periodic comet is the one generally known as Halley's. This comet has been a notable one in the history one of the most remarkable apparitions occurring in 1066 A.D., about the time of the Norman conquest of England. The Bayeux Tapestry depicts this visitation. Some periodic comets have periods of only a few years, while others occupy a great stretch of years in completing a circuit. Halley's comet returns at intervals of about three-quarters of a century. Some of the information obtainable with respect to the regular visitors is involved in a measure of uncertainty largely because of difficulties of identification.

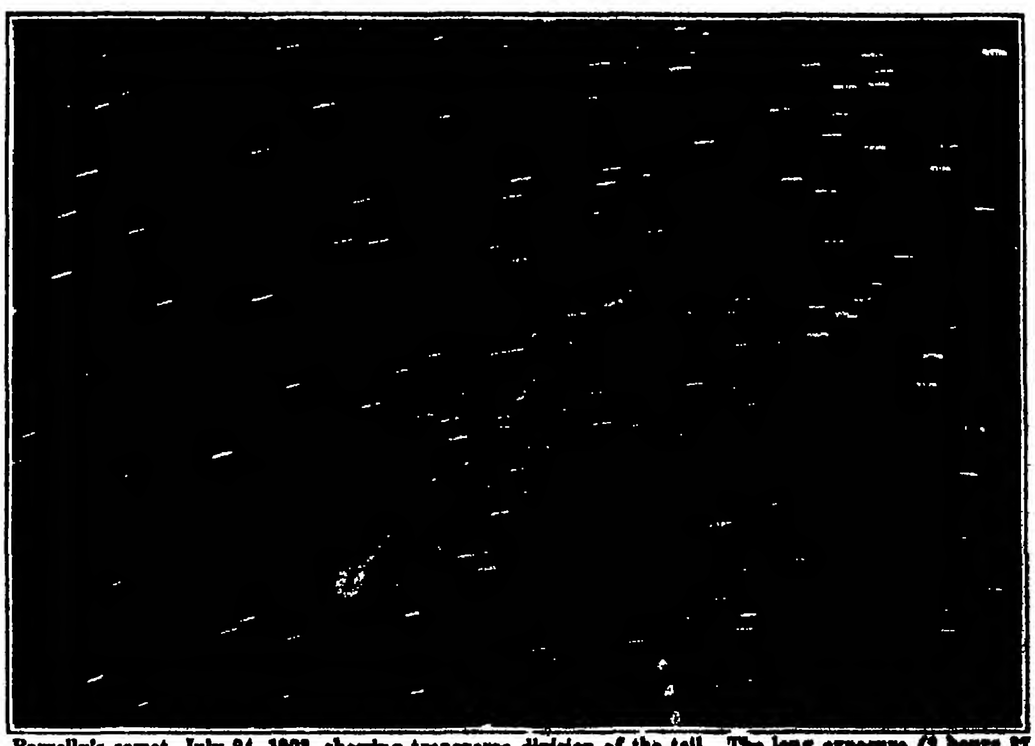
One of the most remarkable things about comets is the presence of a tail. Not that all have them. Many possess such appendages, and some make marvelous displays. However, the tail appears to be a transient affair somehow due to the comet's proximity to the sun. A periodic comet which displays a magnificent tail at one apparition may show little or nothing of this character upon another occasion.

As a typical comet swings swiftly round the sun, the tail seems to swing around as well. Always it stretches from the comet in a direction away from the sun. As the tail may be many millions of miles in length, an explanation is needed to cover the question as to how it is possible in a few days to swing the tail through an arc of 180 deg. Some comets are extraordinarily rapid movers as they round the sun. Thus, the periodic comet of 1843 reached, in its swing round, the wonderful velocity of 300 miles per second. However it is more particularly the rapid angular swing of the tail that needs explanation. If the tail is precisely the same object throughout, a 72 hour swing of a hundred million miles of tail through two right angles would mean that the terminal particles covered an arc considerably over 150,000,000 miles long at the rate of some 600 miles per second. However the tail may have a constant general appearance and yet at no two moments consist of precisely the same aggregate of particles. Examples of such objects are rivers, the flame of a gas jet, etc. It has been conceived that the tail may really consist of very minute particles of matter originating on the comet and swept off into space by the pressure action of light. The reality of light pressure seems to be admitted, and its intensity has been calculated. And light pressure may come to have a more intense effect than does the gravity of planetary bodies. Bodies on the earth are heavy not because a gravitative line of force is especially strong but because it operates within the body as well as on its surface. Light pressure exerts itself upon the surface only, and in fact only upon the one side, while gravity deals with every contained particle. Accordingly the pressure of light upon a ball or a stone is insignificant compared with the force of gravitation. But if the ball or stone be reduced in size indefinitely a time will come when, because of the thinness, the pressure of light will equal the gravitative effort. We have now only to continue the reduction to get a pressure from light much greater than that of gravitation. Particles on an ordinary cometary body not too near the sun would feel but a slight gravitative pull as compared with the centrifugal thrust of light. Under the favorable conditions of the presence of quantities of very finely comminuted matter, a not too massive comet at a proper distance from the sun, and continued access of the sun's light to the material, it seems not at all impossible that the sun should drive off the particles in the form of a continuous jet, and that the tail so far from being an object perpetually identical with itself might really consist of minute particles receding at tremendous rate of speed centrifugally from the sun. The tail would thus consist of a jet of particles, the jet being perpetually renewed at the comet and perpetually dissipated at the far extremity. Such a tail could, if the rate of recession of the particles is sufficiently swift, swing rapidly through 180 deg. even if the length of tail be very great.

However, the material for the tail must be continually supplied from the body of the comet, which would accordingly suffer a diminution of its mass. Out in space, the particles coming away from the tail would seem to be forever under the influence of the centrifugal thrust of light from the sun, the only chance of escape being the advent of a shadow or approach of a body of high gravitative force.

But the flame-like tail is not always constant in its form, continuity and direction. A very recent comet, 1919b, lost its tail suddenly and started a new one. This occurrence took place about October 22, 1919, when the comet was some 6 days beyond the time of its nearest approach to the sun. This comet is really identical with the one discovered by Brorsen in the summer (July 20) of 1847. It was rediscovered in 1919 by Metcalf. The comet is accordingly periodic and its circuit is to be taken as about 72 years in length. It is classed as belonging to the Neptune group of comets, although this most distant planet of our solar system may not have been the cause of the closing of the orbital paths of the members of the group. Halley's comet also has an orbit whose aphelion falls in the region traversed by Neptune. In 1847, the Brorsen-Metcalf comet seems to have remained a strictly telescopic object. In 1919, the apparition made its appeal, though a very moderate one, to the naked eye. Discovered in August, it became distinctly visible to the unaided eye at or before the middle of September. Its considerable visibility continued until a few days after perihelion. At about the middle of its five weeks of visibility, it attained a magnitude of 4½ (Harvard scale).

Even in September, photographic reproductions of the object disclosed the presence of a tail. On the 22nd, it measured 3 deg. in length. The small stump shown by photographs of nearly the same date may very well



Borrelly's comet, July 24, 1903, showing transverse division of the tail. The long exposure (3 hours 37 minutes) results in unusually long star-tracks

have been due to photographic conditions. On Oct. 8, there was again a 3-deg. tail. On the 6th and 7th, this length more than doubled; so that the photographs show tails 7 deg long. The longest tail disclosed by the photographs obtained by Prof E. E Barnard with the Bruce photographic telescope was the one possessed at perihelion. It was 8½ deg. long.

On October 22, the tail was photographically observed as being in two parts. Rather, there was an old part no longer connected with the head and a new part extending from the head in direction 12 deg from that of the old The old tail at its point of nearest apparent contact with the head was still 51 min (or nearly 1 deg) from it It is possible that part of the foregoing is not verifiable from the half-tone reproductions from paper prints. I am however, following Prof Barnard's own statements. The separation of the old tail from the head may, Prof Barnard thinks, be disclosed in an earlier stage in the photographs of October 20—about 48 hours previous "On that date, the tail proper seemed disconnected from the head The rearward portion, which was sharply pointed, was 9°6 from the head while a new and widening tail filled the space between it and the head. If these parts were the same on the two dates, the recession of the particles was at the rate of 21 min a day Photographs made elsewhere will probably decide this question On the photograph of October 20, a brighter condensation about 2 deg long is shown in the tail 2 deg 30 min back from the head

It is possible that one should have been prepared for the loss of its tail by a comet and the generation of a new one in a somewhat different direction by the phenomenon observed long ago of the display of fan shaped tails. If a considerable arc can be filled at one time, it is not a great step to conceive of the arc being supplied in two or more parts successively However, the actual loss of an entire tail does not appear to have been noted prior to 1903, unless one is to take account of Gale's comet of 1894 On July 24, 1903, Borrelly's comet lost its tail and forthwith started a new one. Two photographs appear to have been taken at the Yerkes Observatory upon the eventful night In the earlier, taken by Prof Barnard, there is a split in the appendage which separates the whole into two parts That is, there is a break some 2 or 3 deg back from the head and the portion from this point on was shifted to one side to a position parallel to the direction of the short part next the head. As the shift was on the side of the heavens from which the comet and its appendage were moving, the phenomenon suggested the idea that the old tail had become separated from the head and was being left behind The second photograph, taken by Mr R. J Wallace on the same night as the former one by Prof Barnard, disclosed the same general features, only in a further stage of development. Photographs taken on the nights of the 23rd and 25th show nothing unusual; so that what occurred in the interval was an event of short duration. The following details will be of interest The earlier photograph showed a tail next the head 2 deg 51 min long while the later one disclosed this same member as 4 deg 7 min long As the interval between exposures, center to center was 2 hrs 59 min, one allows that length of time for the increase in length Upon this basis, one puts the growth at about 25 min per hour The recession of the discarded tail is in contrast with this. The earlier photograph showed an interval between head and lost tail of 2 deg 14 min while the later view disclosed the same interval as one of 2 deg 48 min The recession is, then to be taken as about 12 min per hour—or approximately one half the rate of the growth of tail

The Brorsen-Metcalf comet, October 22, 1919, showing unusual diffusion of the tail

Brooks comet of 1893 is notable as one which disclosed a variation in the direction of the tail of 15 deg in the course of 24 hours. See SCIENTIFIC AMERICAN August 8, 1908, for views of this comet On one night, the general direction of the tail agreed pretty closely with that of a radius vector centering in the sun and passing through the comet On the following night, the tail had apparently shifted, as it was now at an angle of about 15 deg with the radius vector Is this to be taken as indicative of an expulsive force emanating from the comet itself and competent to modify the general law to the effect that the tail extends along the radius vector?

Morehouse's comet belongs to the year 1908. Upon the night of September 30, a fan like tail was discovered by a Yerkes photograph taken early in the evening Later on during the same night, a photograph shows the tail with a very narrow connection with the head The tail itself appeared cyclonic in form and structure" By the following night, the appearance had undergone a very remarkable change There was a mass of cloud like material at a considerable distance from the head and next the head a number of rays. Some of these are short, but others perhaps extend out as far as the cloud like mass. Apparently, what has taken place in the interval between the views belonging to the two nights was the loss of the tail and the generation of a new one The cloud like mass is to be considered the tail of the night before that was seen with only a narrow connection It would seem as if we must reckon Morehouse's comet (1908) as one that lost its tail

Halley's comet in its visit of 1910 disclosed upon the night of June 6 some remarkable features. Upon this night, a photographic observation discloses that a secondary head was to be seen about 1°61 back from the comet proper This head had its own tail only its direction from the main tail belonging to the comet itself was at an angle of about 15 deg This tail was traced on the plate made by Dr H D Curtis at Lick Observatory as extending to a point 16 deg from the nucleus On a view taken on the night of June 5, there is to be seen a small streamer near the nucleus, which Dr Curtis thought might have been the source of what was disclosed the following night

All in all the phenomena attendant upon cometary tails are perhaps becoming better understood because of the precision and sensitiveness of photographic methods but at the same time new phenomena are brought to our attention by these same methods. Consequently, the problem is never solved.

Morehouse's comet, October 15, 1908. Here, as in every comet picture, the telescope, set to follow the comet, is in motion with respect to the stars, which make short tracks across the photographic plate

The Proportion of the Various Elements of Our Globe

SOME new data have recently been published by Mr F W Clarke, under the auspices of the United States Geological Survey, with regard to the elements of which our globe consists so far as they are known to us. Oxygen constitutes nearly half (47 per cent) of the lithosphere i e the crust of the earth for a depth of 15 to 20 kilometers, and more than 85 per cent of the hydrosphere, i e, the ocean Next to this is silicon which is the solid element most widely found Taking the three spheres together (air water, and earth) oxygen represents about 50 per cent of them and silicon 25 per cent. Next in order are aluminum (7 per cent), iron (4 per cent), calcium (3 per cent), magnesium sodium, and potassium (a little more than 2 per cent each) and hydrogen (less than 1 per cent)

A Catapult and Turntable for Airplanes

The Navy's Device for Launching Airplanes Into the Wind, Without Changing the Course of the Ship

IN addition to carrying aircraft on special vessels known as aircraft carriers, it is anticipated that fighting and spotting planes may in future be carried on battleships and cruisers, although it is clearly impossible to provide these ships with the flush deck as in the case of the carriers. To permit the launching of airplanes from a battleship or other war vessel, the catapult has been resorted to, and a special type of catapult has been developed at the Philadelphia Navy Yard which has been designated a turntable catapult because the catapult mechanism proper is mounted on a turntable so that it can be pointed into the wind when launching a plane. One catapult of this type could be installed on every battleship and could launch when needed a fighting airplane so that a fleet of battleships would be able upon the approach of hostile bombing airplanes to send into the air instantly a large number of fighting planes to shoot them down before the bombing attack could be developed. This is the real answer to the threat of the bombing plane, which was demonstrated in so spectacular a manner by the recent bombing from the air of the ex-German warships.

Launching a float type of seaplane by means of the new catapult and turntable device

In the bombing attacks of these ex-German warships it was shown that bombs dropped from the air could do material damage to warships which did not defend themselves. Obviously a warship can defend itself by anti aircraft gunfire, but better by attack in the air. The weapons of offense and defense in the history of Naval Warfare have always developed step by step and the development of the heavy bombing airplane is being met by this development of a catapult which will shoot fast combat planes from the decks of battleships into the air to repel bombing attacks.

The catapult of this particular type is new, but the elements are the result of Navy catapult development initiated in 1911 by Captain Washington I. Chambers at that time in charge of Naval Aviation experiments. The first flight was made November 12, 1912, by Commander, then Lieutenant, T. G. Ellyson in a Curtiss seaplane from a catapult. This early catapult was highly experimental, and while the first flights were successful the device was not entirely satisfactory. The matter was resumed in 1915 when the development of Naval seaplanes had proceeded to such a point that it was clear to the Navy it would be desirable to take aircraft to sea. A new design of catapult, based on experience with the first one, was installed on the stern of the armored cruiser "North Carolina," and successful flights were made. The "North Carolina" installation proved so reliable that similar catapults were installed on the armored cruisers "Seattle" and "Huntington," and during the early winter of 1916 successful flights were made from these cruisers. At the time the United States entered the war the principal Naval effort was anti submarine in its object and the convoy of shipping. Aircraft were not needed aboard these cruisers for this purpose and the catapults were removed. After the armistice, the catapult problem was again taken up and a catapult, similar to the "North Carolina" design, which had been in use at Pensacola for training aviators while mounted on a coal barge, was brought to Washington and further tests and investigations made. The result of this investigation led to the design of the present turntable type of catapult which has now been completed at the Philadelphia Navy Yard and mounted on the water front for practical testing with aircraft.

The old catapults, such as were used on the "North Carolina," consisted of a track along which a carriage was propelled by a compressed air cylinder. The airplane was mounted on this carriage, and as the carriage speeded up it released the airplane at the end of its run, allowing it to fly into the air. The track for this catapult was mounted along the center-line of the ship, and since it was necessary to launch the airplane direct into the relative wind, it was necessary for the ship to set herself on such a course that the wind blew in the direction of the catapult track. This maneuver, while entirely feasible, necessitated the ship turning out of formation, or heading upon some course which might prove very disadvantageous. For a battleship it is considered impossible to require the ship to leave formation and to head upon a course which is possibly of great tactical disadvantage only for the purpose of launching a plane. These considerations led to the development of the turntable catapult, which permits the ship to proceed upon its usual course in formation while the catapult is trained like a turret into the relative wind.

The turntable catapult consists of a bridge-like structure mounted on a turntable upon which there is the usual car which carries the airplane, and this car is propelled by compressed air. Frequent tests have demonstrated that it is possible to launch by such a mechanism any of the types of airplane or seaplane which would be carried upon a battleship.

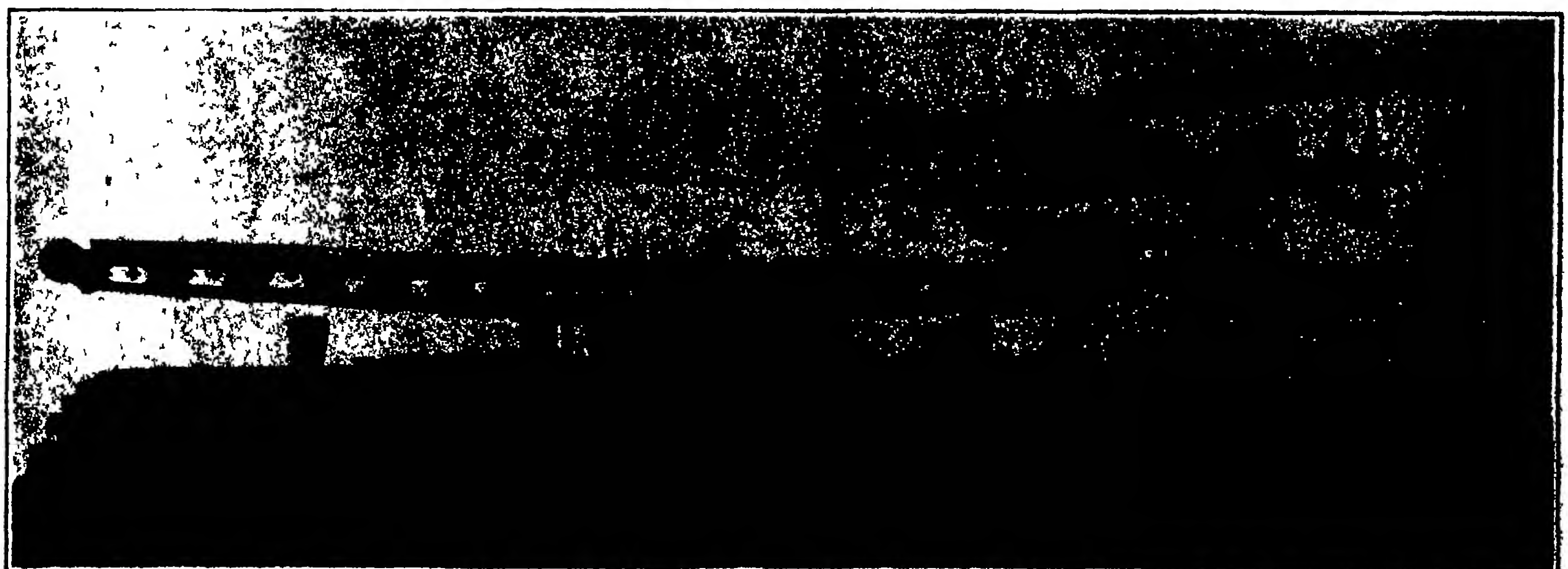
The problem of launching an airplane in a short run by means of the catapult depends upon several factors. The first and primary one is, of course, that at the end of the run the catapult should have given the plane a speed such that when the plane is released from the car the wings will lift it into the air and flight has begun. This requires that the launching velocity shall be *somewhat in excess of the minimum flying speed of the plane.* Second, it is necessary while the plane is being brought up to this flying speed that the plane be held securely to the launching carriage in order that it will not leave the track too soon. Finally, it is necessary that the acceleration of launching shall not be so great or so violent as to injure the pilot, who must ride in the plane and preserve all his senses alert in order to take charge as soon as he is released at the end of the run.

The development of a successful catapult to accomplish these desired things is believed to mark an important step in providing our fleet with aircraft, and with these turntable catapults, which are relatively small and compact, it is possible to provide the individual vessels of the fleet either with airplanes which can be launched from catapults when desired, but which will land upon an aircraft carrier when their mission is completed or, alternatively, the warship may carry seaplanes which can be launched from the catapult in a similar manner, but which will land upon the surface of the sea and be hoisted aboard like a ship's boat. Until such time as the Navy is provided with a suitable number of aircraft carriers it will be necessary to use seaplanes for work with the fleet. Under many conditions the seaplane in its present state of development is entirely practical, although in very rough weather a landing upon the sea is likely to mean the damage if not loss of the seaplane, although it is to be expected that the aviator can be rescued. The conditions of the weather, however, are not believed to offer any inconvenience to launching by means of the catapult, and in time of war the commander-in-chief will launch his planes in the air where they may accomplish their mission regardless of whether or not the planes may be salvaged intact upon their landing.

Discovery of Coal in Lorraine

IMPORTANT coal deposits have been discovered in Lorraine, according to a news item recently published in France. These deposits represent extensions from the south-southeast of the Saar Basin and roughly pass by the towns of Forbach, Pont-a-Mousson, Nancy, Luneville, and Mirecourt. In the first two districts 75,000 hectares (1 hectare = 2.47 acres) have been surveyed and have been found to contain a supply of coal from which it is said that the French could extract about 10,000,000 tons a year.

Stocks of coal in France at the end of July were estimated at 4,401,645 tons, there being 1,550,550 tons at the French mines, 269,179 tons in the Saar Basin mines, 536,130 tons at the French ports, and 1,663,200 tons with the railroads.



Combination turntable and catapult device with float type of airplane in position, ready for launching. The seaplane can be launched into the wind without changing the course of the ship

Vehicular Tunnel Ventilation

Tests In An Old Coal Mine, with Regular Automobiles, Under Operating Conditions

VEHICULAR tunnel ventilation tests under the direction of the U. S. Bureau of Mines, conducted at the Illinois Engineering Experiment Station and Yale University, have been described fully in previous issues of SCIENTIFIC AMERICAN and have been logical forerunners of the final tests now in progress at Uncle Sam's experimental mine, Bruceton, Pennsylvania, where a circular and tightly enclosed subterranean trackway 800 feet in diameter has been constructed upon which ordinary, average-sized automobiles are being operated in order to test out the proper dilutions that are essential to render the poisonous exhaust gases non-injurious to man. All these investigations are of basic importance as the results of these tests will be useful in solving the ventilation difficulties of the huge Hudson River vehicular tunnel, the largest underground passageway of its kind ever attempted.

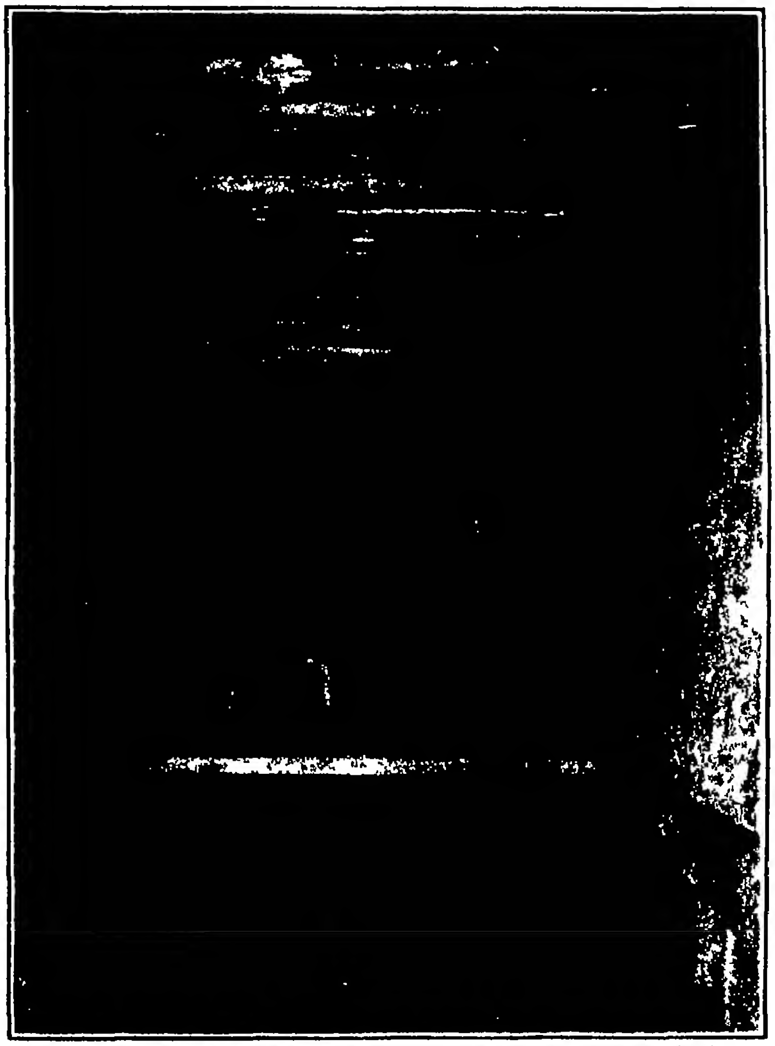
Three unusual problems were involved in planning the ventilation of this tunnel which were unprecedented as far as engineering experimentation was concerned. It was necessary to ascertain accurately the amount and composition of exhaust gases from motor cars, the dilution essential to render these exhaust gases harmless and the determination of the coefficients of air flow and horsepower required in model ducts, bends, and openings. Road tests were made on 101 different automobiles and trucks at the Pittsburgh Experiment Station of the Bureau of Mines, these machines being taken from active service without any additional adjustments so that the amount and composition of the exhaust gases were representative of actual operating conditions. The results of these tests showed that the percentage of carbon monoxide (the poisonous constituent of automobile exhaust gases) for the various cars varied from 0.5 to 14 per cent., passenger cars and speed trucks on level grades at 15 to 20 miles per hour averaged 7 per cent and 1½ to 5 ton trucks at 10 miles per hour averaged 7.8 per cent carbon monoxide.

These data combined with a traffic count of the approximate number of motor vehicles which would use the tunnel per hour enabled the engineers to compute the total amount of exhaust gases that would be evolved in the underground automobile subway. Actual tests on men and animals were then conducted at Yale University to determine the largest proportion of these exhaust gases in the air that man could breathe without suffering any harmful effects. It was determined satisfactorily that when the exhaust gases were diluted with fresh air to the point where the concentration of carbon monoxide did not exceed 4 parts in 10,000 parts of air, no harmful results were obtained. These results agreed with practical experiences of the government engineers with regard to the effect of carbon monoxide in mine gases, and around blast furnaces and gas producers. Subsequently tests were run in an experimental tunnel erected at Illinois State University at a cost of $50,000 relating to the best methods of supplying the fresh air and with reference to the flow of air in a concrete tunnel and its ducts, bends, and openings.

The final check on the solution of all these problems is now under headway at Bruceton, Pennsylvania. An oval tunnel, or rather an underground oval track, having similar construction of ducts to those proposed in the Hudson River tunnel and an axial length of 400 feet, has been constructed through the channels and galleries of an experimental coal mine owned by Uncle Sam. The cross-section of this test tunnel is 9 feet wide and 8 feet high. Above the ceiling of the tunnel an air duct 3 feet high has been installed, and below the floor another air duct 2½ feet high has been built. Either duct can be used for introducing fresh air or for exhausting the contaminated air. The tunnel cross-section is sufficiently large for accommodating the smaller types of moderate priced 5-passenger automobiles.

The tunnel is completely equipped with sensitive apparatus for measuring the temperature, humidity quantity, velocity, and pressure of the air in various parts of the tunnel. A total of 48 air sampling tubes is installed on eight cross-sections of the novel test tunnel, in order to obtain samples for chemical analysis, for determining the diffusion and concentration of exhaust gases in various parts of the tunnel with different methods of ventilation. An important part of these experiments will be the comprehensive physiological and psychological observations made on the effects of temperature, humidity, rate of air flow, smoke and exhaust gases on the men driving the test cars.

Ten small cars of a popular make and model are spaced 40 feet apart and are run at a speed of 10 miles an hour through the underground passage. Twenty-one thousand cubic feet of air per minute, sufficient to maintain a concentration of 4 parts carbon monoxide per 10,000 parts of air by volume are passed across the tunnel during the tests. The driver and



800-foot test tunnel for automobile exhaust gases in abandoned coal mine

observer in each car are subjected to examination by expert physicians and psychologists after each test. The amount of carbon monoxide absorbed by each person during the trials is ascertained by examining a few drops of blood drawn immediately after the test is concluded. Remarkably sensitive methods of examining these blood samples have been perfected. The effect of smoke and temperature on the motor car drivers and observers are also carefully studied.

The underground miniature tunnel in the coal mine is being used in these check experiments because it more accurately represents conditions which will prevail in the Hudson River tunnel when completed than could any above-ground model, no matter how painstakingly constructed and designed. It is situated 130 feet below the surface of the ground and 1050 feet in from the pit mouth of the mine. The temperature within the mine is practically constant and is free from unavoidable leakages of air which invariably obtain in above-ground models. The average ground temperature in the mine is about the same as that underneath the Hudson River. Means are provided for heating and humidifying the air to approximate the conditions that may occur on the hottest summer days.

Tropical Geology and Engineering

IN an article on this subject by Warren D. Smith, Acting Chief Division of Mines Bureau of Science, Manila in the *Philippine Journal of Science* the author discusses, first, the general geologic processes as they are found at work in the tropics, contrasting their effects with the same processes in the temperate regions of the earth, and second cites some examples showing their practical bearing upon the engineering problems that arise in those regions.

It is found that the geological agents at work in tropical regions are the same as those found operating in temperate parts of the earth, with the difference that they are often greatly accelerated in the former. In the Philippines structural conditions are of prime importance in engineering. Both major and minor faulting occur here which as yet have not caused trouble save in mining operations.

In general it is found that in tropical countries like the Philippines both road location and maintenance are much more difficult than in the United States and Europe, and that both dams and reservoirs should be avoided if possible. Weathering of the rocks in tropical regions is notable. The so-called laterite, in some places of considerable economic importance, is a product of weathering. It is characteristic of many tropical countries. The author also finds that the geologic work of organisms is great in the tropics, though little studied, and that the work of tropical rain and running water is not appreciated as it should be. Handbooks and formulæ prepared by engineers acquainted only with conditions in temperate regions are worse than useless in the tropics. They are positively dangerous.

Engineers as a whole should, if possible, give more attention to the study of modern geology, which is no longer merely a descriptive subject but is becoming more and more a close relative of engineering.

The Causes of Twins

IN an interesting article, of considerable length, on the experimental production of twins and double-monsters, in the *Journal of Experimental Zoology* for July, 1921, Professor H. H. Newman, of the University of Chicago says concerning the causes of human twinning:

Davenport has recently published data that tend to show that monozygotic twinning is inherited strongly through the male parent. If this claim is valid, how could this fact be shown to accord with the general theory of twinning herewith expounded? If in human beings twinning be a result of temporary retardation followed by recovery, how could the sperm be responsible for retardation? It is evidently true that in human beings as in other animals, there are varying degrees of compatibility between the eggs of some females and the sperms of some males. Doubtless the eggs of some females are totally incapable of fertilization by the sperms of some males, while quite fertile to the sperm of others. Doubtless also there are many borderline cases that involve relative incompatibility and consequent disharmony and retardation. If retardation be sufficiently severe physiological isolation might occur at a relatively early period, which would likely result in completely separate twins, but if physiological isolation occurred relatively later, there would be a less complete separation of the twin bodies, and the resultant conjoined twins, cases of dicephaly, spina bifida, and other types of teratological duplication common in human fetuses. Thus twinning might be inherited through the male line owing to some peculiarity of sperm in a given race that has a retarding effect upon the egg. The entire subject is one richly deserving of further investigation which will necessarily proceed slowly.

General view of the Germantown dam from below, showing conduit openings and hydraulic jump

The Hydraulic Jump

How Nature's Treatment of Rapids and Waterfalls Is Copied in Ohio's Big Impounding Dam

THE most important news of a year of progress on the history making project in flood prevention at Dayton Ohio, is that the hydraulic jump is a success. The hydraulic jump is a device for removing from the waters impounded behind the great dams in time of flood their destructive energy as they rush through the two concrete conduits which are the only outlets. Within the past year one of the five dams has been entirely completed, and this feature has been given a test more than half as severe as would be experienced in a repetition of the disastrous 1913 flood. In this test the performance of this hitherto untried device bore out the calculations of the engineers to a nicety.

In many respects the Dayton project is a pioneering venture. The principle of the impounding dam is new in this country. Under this scheme the three river valleys which converge above Dayton are blocked by huge dams. Concrete conduits are provided through the dams of sufficient capacity to more than care for the flow of the rivers. Thus in normal times there is no water behind the dams. But when the waters reach a flood stage the conduits are no longer large enough to permit the full flow of the waters and the excess backs up behind the dams, forming huge reservoirs. The waters in these reservoirs gradually flow off until the river again is within its banks. The capacity of these outlets is so calculated that at maximum flow the capacity of the river channel below the dams is not exceeded.

In addition to the three dams above the city of Dayton there are two smaller dams, one to protect the city of Piqua and the other the city of Hamilton. The so-called Germantown Dam across the valley of Twin Creeks above the city of Hamilton has been first completed, and here a short time ago occurred the first real test of the "hydraulic jump."

It might seem at first thought that the "hydraulic jump" is a matter of only secondary importance whereas in fact it has been regarded as one of the most important features of the dam design and has been given more thought than perhaps any other. A design was not finally adopted until after a year of research and experimentation with various designs of outlet basin.

The importance of the problem may be realized from the fact that the water pouring from the twin conduits each minute at the crest of a flood of the magnitude of that of 1913 equals more than the combined energy of six fifty-car freight trains going at 37.5 miles an hour. Such tremendous destructive energy, if unchecked, would do great harm below the dam.

The mechanism is a simple one—an adaptation of a device often seen in Nature doing a similar work. We are all familiar with the usual deep pool at the base of a falls or rapids which receives and absorbs the impact of the rushing waters, with jagged rock bottoms to further impede the flow. The problem was to convert this simple mechanism to the mathematics of the engineer, in order to design for strength and the greatest efficiency.

As finally worked out the outlet basin is built of concrete and bedded on solid rock as it needs must be to withstand the impact of such powerful masses of water. It consists in a widening and deepening of the conduits below their outlet into a double concrete basin which opens downstream into the creek channel. Each conduit is thirteen feet wide, while the width of the double basin is 85 feet. The basin floor slopes down to an extreme depth of sixteen feet below the conduits. The bottom of the basin is built in irregular steps and obstructing walls are provided.

Both in this pool and in brook rapids, where the swift current strikes the slower water of the pool below there is formed what is aptly called the "hydraulic jump." In the case of the brook the "jump" is likely to be rather imperfect, whereas the jump in this basin takes the form of a straight stationary wave. The water from the conduits shoots into the base of this wave and by its momentum holds back the wall of water, which may be from six to ten feet high. The top of the wave constantly tumbles forward, giving the appearance of a great beach "comber" excepting that the wave does not move forward. One of the difficult problems of design was to locate exactly the spot where this wave would occur so that the engineers could meet in design the tremendous pounding of the water at this point.

There are three ways in which the "hydraulic jump" operates to destroy the velocity and kill the energy of the water as it issues from the conduits—by compelling it to do work in lifting the mass of water below, by means of friction and by an effect which might be termed diluting the flow of speed by spreading it out over a deeper and wider channel than it had in the conduits. The water is churned into foam, and these millions of bubbles also exert a frictional retarding effect.

During the recent small flood the flow through the conduits reached a speed of 29 feet per second. The combined effect was to reduce this to a speed of 5.5 feet per second in the creek below. The actual effect however, of killing the destructive force of the water was greater than these figures indicate, due to the fact that the power of destruction varies as the square of the speed. Thus a train going at 50 miles an hour, if it struck another would smash things up with 25 times the force exerted if the same train were wrecked while going at 10 miles an hour. If this law be applied to the results obtained in this test it will be seen that 26/27 of the total destructive power of the water was "killed," and that only 1/27 remained.

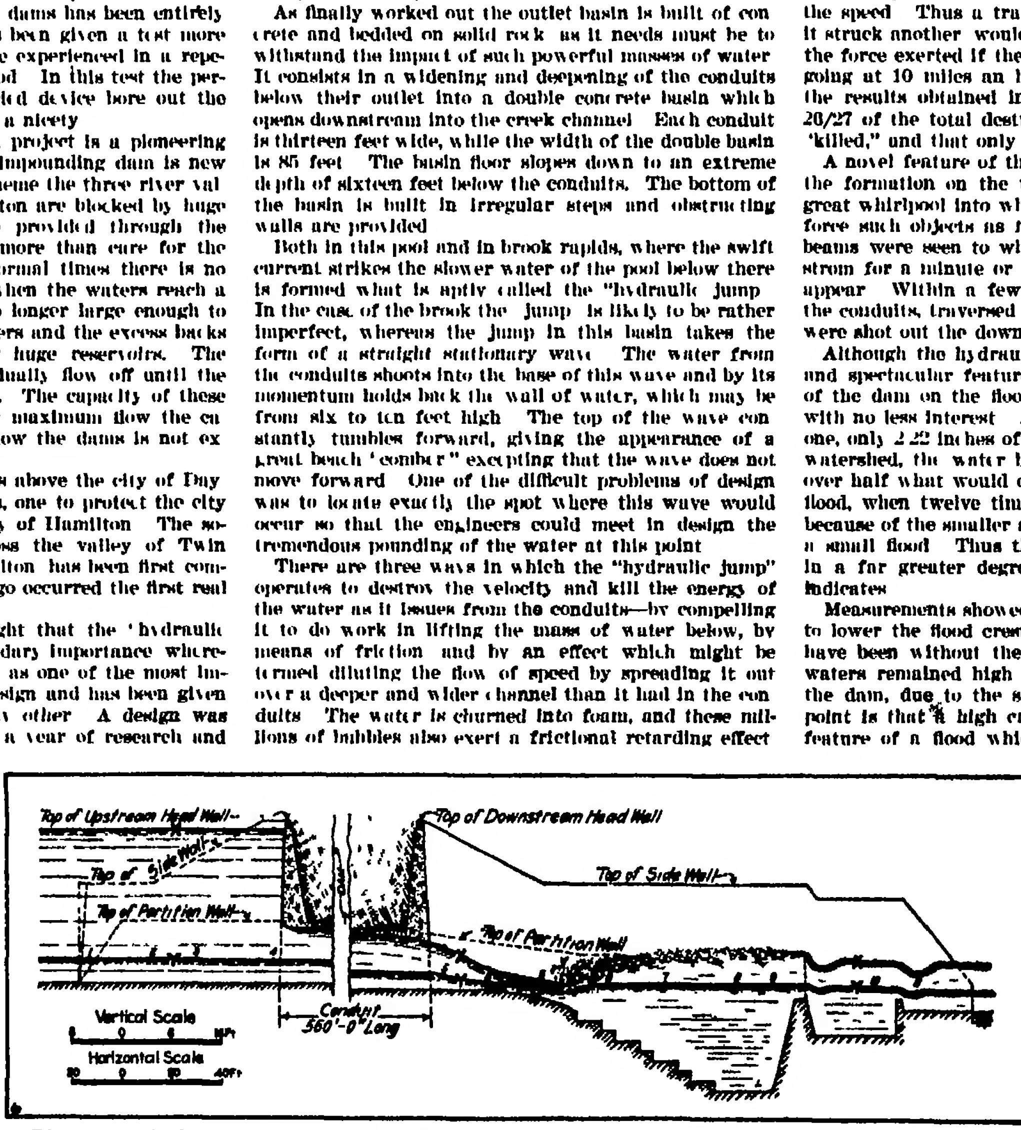
A novel feature of the operation of the conduits was the formation on the upstream side of the dam of a great whirlpool into which was sucked with irresistible force such objects as floated near it. Logs and great beams were seen to whirl about the edge of the maelstrom for a minute or two, then stand on end and disappear. Within a few seconds they were sucked into the conduits, traversed the 500 feet under the dam, and were shot out the downstream side.

Although the hydraulic jump formed the most novel and spectacular feature of the test, the general effect of the dam on the flood waters below it was recorded with no less interest. Although the storm was a small one, only 2.22 inches of rain falling on the Twin Creeks watershed, the water behind the dam rose to a height over half what would occur in a repetition of the 1913 flood, when twelve times as much water fell. This is because of the smaller area covered by the water during a small flood. Thus the flood was valuable as a test in a far greater degree than the amount of rainfall indicates.

Measurements showed that the effect of the dam was to lower the flood crest 3.25 feet below what it would have been without the dam. On the other hand, the waters remained high for a longer time than without the dam, due to the slow rate of release. The main point is that a high crest was avoided, and it is this feature of a flood which always causes great damage to life and property.

From these observations it is calculated that the crest of another 1913 flood would be lowered by this dam by 14 feet. Thus it is seen that the dam rapidly increases in efficiency as the size of the flood increases.

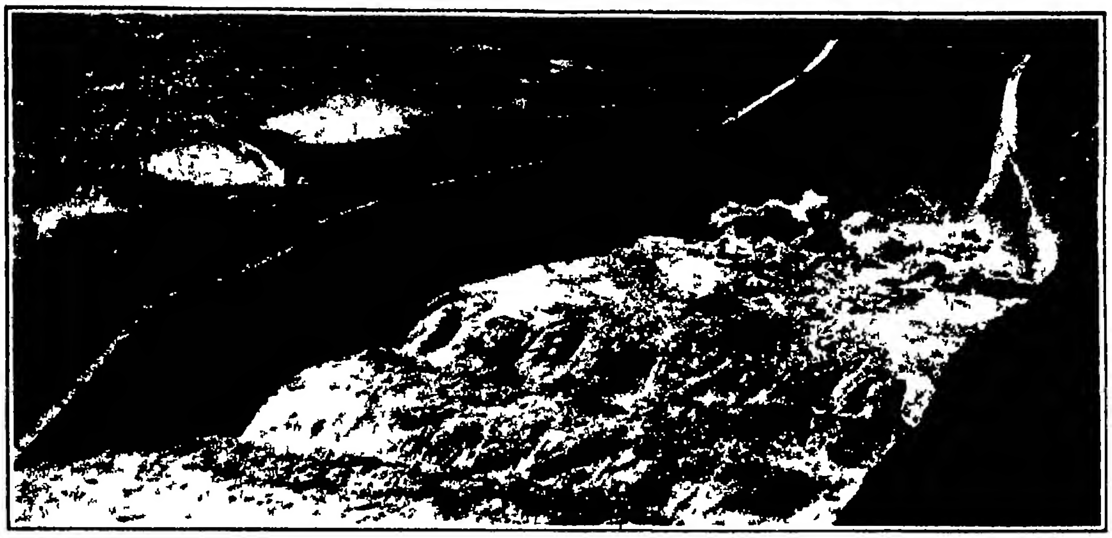
The construction of the dams and the channel work on the project has now reached a stage where it is confidently stated that if Dayton escapes any serious floods until this winter there will never again be danger of a repetition of the 1913 disaster, one of the greatest



Diagrammatic longitudinal section of the Germantown dam conduits, showing the hydraulic jump

ever to occur in this country

With one of the minor dams completed, another of the important dams above Dayton will be finished by winter, and a second by spring. The third will then be near enough completion to care for a very large flood without danger. The plan has been, during construction, to make a great concrete P shaped outlet to allow a somewhat free flow of water from behind the dams in case of flood, so as not to imperil the structures before completion. When the dam is brought to its maximum height a great concrete wedge is poured in this outlet, blocking it completely, excepting for the two conduits left through the base. At the same time the dams are nearing completion extensive changes in the river channels are also being finished. It is expected that the job at a total cost of over $50,000,000, will be completed by January, 1923.



Close view of hydraulic jump, showing the action of the water

The Legal Adviser in Foreign Trade

IN the general scheme of foreign trade promotion the sales manager, the credit man, the foreign representative, and a score of other factors of varying importance—from the banker to the freight broker—have their recognized place and activity. *It is only of late*, however that the business world has commenced to accord a growing recognition to the legal adviser as an essential, and occasionally the most essential, link in the organization of international trading.

So imperceptibly have the events of recent years drawn the lawyer into the councils of those who plan and direct foreign trade that the legal advisers of exporting merchants and manufacturers are frequently unaware of their own importance in the economy of foreign trade. Merchants and manufacturers engaged in foreign business had been seeking light on foreign laws long before their legal advisers thought enough of foreign trade to make it a subject of special study. And taking into consideration the vast interests involved in American trade with foreign countries, the equipment of the average American attorney when confronted with the legal problems of foreign trade has been, with a few exceptions, inadequate.

Now and then, in former days, the exporter's counsel had to prepare a power of attorney for use abroad; now and then he was called upon to present the proofs of claim in the case of a foreign bankruptcy, now and then he had occasion to make inquiries for some reputable attorney in a foreign land to take care of litigation, and the mysteries of foreign laws generally proved exasperatingly baffling.

The average lawyer, enjoying the confidence of his clients because of his familiarity with domestic law, was at sea when facing the laws of other lands. Even if he could lay his hands on foreign codes, frequently he could neither read nor apply them with any degree of assurance. He was like a conscientious general practitioner called upon to treat ailments which require the skill and the experience of a specialist. Foreign laws he soon discovered are largely the field of specialists. And such specialists until recent days, if not until the present day, have been very few.

Here and there a farseeing and daring American studied law abroad and sought admission to the bar of some foreign land. Such lawyers have established themselves in France, England, Italy, and Germany, in Brazil, Mexico, Cuba, Argentina, and a few other countries. Here and there foreign barristers associated themselves with American attorneys, and a bare handful of international commercial law firms sprang into existence, chiefly in New York City and in a few foreign cities American lawyers associated themselves with native practitioners in a similar way. The few world famed jurists specializing in international law in colleges or in diplomatic service, of course, are not available to commerce.

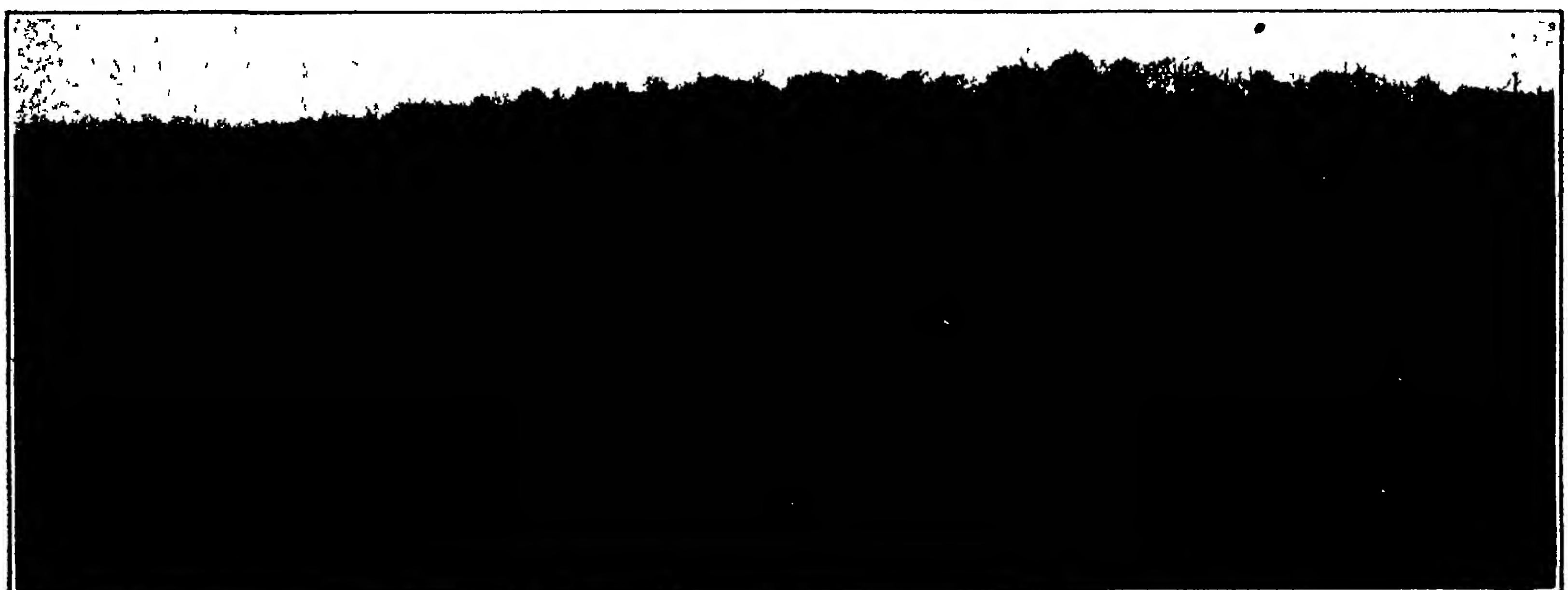
A considerable number of American attorneys, including the law departments of prominent corporations have established working arrangements with legal confreres abroad selected with more or less discrimination and good luck. A still larger number rely on the unsatisfactory medium of printed lists of foreign attorneys. The vast majority have no foreign connections.

With regard to library equipment, one or two great law schools have excellent collections of foreign codes; one or two libraries of national fame have foreign law books on their shelves—but without any attempt at being either complete or fully up to date, a few law firms have built up libraries covering one or more countries, and several nonpracticing international jurists have law libraries of their own which include foreign law works. But the great body of the legal profession has no access to a complete library of foreign codes, has no worldwide network of legal coworkers abroad on the basis of any permanent mutual arrangement and most lawyers are entirely at sea when their clients bring before them legal problems abroad for advice and attention.

The political and economic disturbances in the wake of the war have multiplied the legal difficulties of foreign trading. The business men of America have demanded more information on the subject of foreign commercial laws, and this need has been recognized in the creation of a Division of Commercial Laws in the Bureau of Foreign and Domestic Commerce which aims to compile laws, to collect codes, to edit them for use in *Commerce Reports* and eventually in special pamphlets, to collect foreign decisions of interest to American commerce, and to list reputable legal practitioners abroad. It can not, of course, undertake to render legal opinions or to prepare briefs—this is the province of the practicing lawyer. Much of this information is of technical character *and requires the attention of the legal adviser, even as* credit matters naturally come before the credit man and sales opportunities before the sales manager.

It is the legal adviser who prepares the power of attorney for the foreign representative, who draws up the incorporation papers when it is decided to form a branch or a subsidiary company abroad, who plans the entire policy of a firm before a new field of operations is invaded, who is consulted in the case of legal difficulties abroad, who studies the legal aspects and the meaning of letters of credit and of contracts of sale or of agency in foreign commerce. Not only the merchant and the manufacturer, but the bank, the insurance company, the freight forwarder, the shipping company find it indispensable to obtain legal advice on every phase of foreign business before they commit themselves. So the legal adviser of an American organization engaged either in active trading or in any of the auxiliary activities of commerce must study foreign trade in all of its aspects.

The American Bar is beginning to realize the potentialities of efficient service in the newly created Division of Commercial Laws and many letters have been received from the leaders of the legal profession expressing interest in its work.—*By A. J. Wolfe*, Chief, Division of Commercial Laws, U. S. Department of Commerce.



Driveway over the top of the big impounding dam, with a partial view of the surrounding country

Our Point of View

REVIEW OF THE YEAR 1921

Civil Engineering

A GREAT part of the work of the civil engineer is devoted to overcoming obstructions which Nature has placed in the way of easy transportation of passengers and freight. Two notable examples of this are to be found at New York and San Francisco. At the former city the 30-year old project for crossing the Hudson River by a great bridge has moved during the year into its preliminary stage of survey, design and organization. When this has been passed construction will begin and five years will suffice for erection. What the Hudson River as an obstruction has been to New York, San Francisco Bay has been to San Francisco and the great suburbs of Oakland and Alameda. Here it is proposed to cross the Bay by a 6½ mile structure consisting of a great railroad fill followed by a steel bridge across the shoaler portions of the Bay, and by a subway extending from the bridge to San Francisco below the main channel of the harbor. Each of these engineering works will be unprecedented in magnitude, the Hudson River bridge having a central span of 3240 feet, which is nearly twice the length of any existing span, and the San Francisco Bay crossing being from two to three times the length of any crossing of the same general character.

A matter of considerable importance to the bridge engineer was the report of the United States Bureau of Public Roads on the magnitude of the impacts of wheels upon the road surface, a question which has a serious bearing on the design of bridges. Too much in the past have designers been content to determine merely the static stresses, giving little attention to the question of the hammer blow of heavy and swiftly moving locomotives and cars.

The most interesting event in tunnel construction was the commencement of work on the great vehicular tunnel beneath the Hudson River between New York and Jersey City. Thanks to an unusually elaborate series of experiments undertaken by various technical bodies, it has been demonstrated that the carbon monoxide content in this tunnel can be kept at a safe low point by a properly designed system of ventilation.

There has been a fair amount of activity in hydraulic engineering and in the construction of dams and reservoirs. Work on the great Muscle Shoals Dam has been discontinued on the score of expense, and although an industrial magnate has offered to take the work over and complete it, we believe that the project is still in abeyance. The importance of this scheme may be judged from the fact that the dam will equal the Assuan Dam on the Nile in height and exceed it in masonry content. The most important proposed waterway is the Great Lakes-to-the-sea canal by way of the St Lawrence. Its promoters aim first, to open up a channel sufficiently deep for ocean going vessels, from Lake Erie to Montreal and second, to impound sufficient water to provide an enormous addition to the available hydroelectric power of this country and Canada. The canal would cost several hundred millions of dollars. It has been urged, and justly so, that the effort of the people of New York State should be devoted to the upbuilding of the traffic of their own State Barge Canal before lending assistance to what is, after all, a rival project.

Railroad and Automobile

Although little railroad building is being done, a glance at the map of the world shows that its civilized portions are not so badly supplied with this form of transportation. In the United States alone there are 256,572 miles of track over which 1¼ billions of passengers and 2½ billions of tons of freight are transported annually, the cost of this great system being some 21 billion dollars. The railway mileage of all the world is estimated to be about 720 000 miles. Effort during the year has been directed to repairing the damages and making good the neglect of the war period. The tendency in the United States is toward heavier engines and larger cars. Weights and capacities are enormous. The most powerful passenger locomotive weighs 280 tons and is capable of hauling twelve to sixteen Pullmans at 60 miles an hour on the level, and the largest freight engine weighs 450 tons, and has actually drawn, of course at a moderate speed, a load of 17 000 tons on an up grade of two tenths of one per cent.

Increasing attention is being paid to the improvement of terminal and station yard facilities, with a view to increasing the average speed of freight movement. Port and terminal congestion has reduced the average speed of movement of a car of freight to the low figure of 20 miles per day. Having reached the limit of size, improvement in the locomotive must be looked for in the direction of improved efficiency, a problem to which increasing attention has been directed during the year. There is a tendency to increase the weights of rails. One hundred pounds is standard, and many miles of 130-pound rails have been laid. One leading authority claims that there would be a distinct economy in the use of 200-pound rails.

A development full of promise for safe and economical handling of freight is the container car, which is meeting with increased favor both in this country and abroad. There is a proposal, which should meet with every encouragement, to utilize the container car in conjunction with the motor truck by building the cars in such units as will match the dimensions of both freight car and motor truck. There is great promise of saving of both time and money in the prosecution of this method. The development of the motor truck goes on apace, and it is significant that the two greatest engineering projects for facilitating transportation, the Hudson River Bridge and the San Francisco Bay crossing, have received their greatest stimulus from the enormous development of automobile travel and motor truck transportation of freight. The electrification of steam railroads where special conditions call for it has received additional endorsement from the successful operation during the year of the electrified mountain sections of the Chicago Milwaukee & St Paul Railroad system.

Naval and Military

A review of matters naval and military must start with the greatest event of the year—the calling of the conference in Washington by President Harding to consider the question of the limitation of armaments. The President is well placed to ascertain the sentiment both of the United States and of the great outside world on any big question such as this, and the hearty response to his invitation shows that all classes and conditions of men, political naval, military, and lay alike, realize the folly and futility of overblown armaments and wish to reduce them to reasonable limits. During the year we have completed the "Tennessee," the last of our 14-inch gun ships, and also the "Maryland," the first American battleship to carry a 16-inch gun. The close of the year finds our fleet unbalanced. We have the most powerful navy in respect to battleships and destroyers, but we have no battle cruisers, and we are relatively weak in our submarine and scouting forces. Expression of opinion as to the propriety of remedying this lack of balance, or suggestion of means for such remedy, are of course out of order while the possibility exists that the matter will be disposed of on other grounds than those of naval expediency, but we can at least suggest that greater effort should go toward the development of our submarine and airplane service.

The outstanding event of the year, at least in the public mind, was the great series of bombing experiments, when the ex-German warships were sunk off the Virginia Capes. The event was spectacular, and that was all. No new facts were developed. We knew, from land experiments, that bombs could be dropped so as to hit a stationary target, traced out on the ground. Hence it was no surprise to see bombing machines hit a stationary target moored on the water. Again, we knew that a heavy charge of TNT exploded below the surface in contact with a ship's bottom (the mine) would greatly injure, if it did not sink the ship. So, also, we knew that such a charge, exploded below the surface and near a ship's bottom (the depth charge) would damage or sink her. Hence the sinking of the battleship "Ostfriesland" by the detonation of 2000-pound bombs below the surface and a few feet from her hull, taught us nothing new. Had the ship been moving at 18 knots, with every anti-aircraft gun trained on the bombing machines, had the "Ostfriesland" been enshrouded in a smokescreen, made by friendly destroyers; had the bombers been subject to the disturbing elements of wind and weather—well, that would have been another story. In brief, nothing happened off the Virginia Capes to "sound the knell of the battleship."

Aeronautics

The outstanding fact in American aeronautics is that the United States is still awaiting the passage of a Federal law for the licensing of pilots, the inspection of machines, and the general encouragement and control of the industry. As matters stand, any man is at liberty to buy or build an inferior machine, take up passengers at so much a head, and kill both them and himself (as not infrequently happens) without a word of official protest. Thus, the art is discredited and the public discouraged. If aeronautics is not illegal it is at best non lawful and will remain so until Congress does its duty. While foreign governments are encouraging aviation, commercial progress in the United States is due entirely to the unaided efforts of the manufacturer and the individual inventor. All honor to them.

Some truly remarkable records have marked the efforts of the past year. In France Sadi Lecointe, in training for the Deutsch Cup contests, achieved a speed of 206½ miles an hour in a biplane, and came pretty close to that mark in the race itself. This was for a short distance, straightaway. The record over a 150-mile closed circuit was gained in the Pulitzer trophy by Bert Acosta in a Curtiss Navy racer, when he covered the distance at an average speed of 170.7 miles per hour. Another startling feat was that of Lieutenant John A. Macready, who on September 28th, rising from McCook Feld, Dayton, Ohio, attained a height of 40,000 feet. He used electrically heated clothing, the oxygen tank, and the gas turbine supercharger. His LaPere biplane was the same in which Schroeder climbed to 38,180 feet in the preceding year.

The all-metal monoplane continues to gain favor, and its performance is characterized by a remarkably low gas consumption, due of course largely to its excellent motor. There has been a remarkable revival of interest in the monoplane as a good type for moderate speeds. The thickness of wing, which is necessitated by internal bracing is unsuitable for the highest speeds. Lecointe used a biplane with the characteristic thin wings of the modern racing machine. Multiple engines, so coupled up as to be capable of being run independently, are growing in favor. Martin and Gallaudet, among American designers, have secured excellent results with this arrangement. Regular airplane passenger service, running on schedule, has made progress, slow, it may be, but encouraging. Abroad, the French and British are still maintaining their London-Paris routes, other services in Europe have been running consistently, and new routes have been established during the year. On this side of the water we have seen the inauguration of the Key West to Havana and other passenger-carrying services. The Air Mail has functioned with a regularity which should encourage Congress greatly to enlarge its scope. Mention should be made of the Petrocsy helicopter, which, in tests, lifted itself to a height of 160 feet. It weighs 2900 pounds and is held captive for

Our Point of View

observation purposes, taking the place of the vulnerable balloon

The prospects of successful dirigible passenger service have undoubtedly been set back somewhat by the offer of the British Government to give away its fleet of six dirigibles, coupled with the failure of any private company to accept the gift, and by the tragic loss of the latest ship "ZR-2." As we anticipated in these columns, the official report indicates that the frame of the ship was too weak to stand the bending moment developed by the sudden throwing over of the vertical rudder Failure came in the frame longitudinals while they were under compressive stress. Always, this has been the weak point in the rigid type of construction An important contribution to naval aviation was the successful test at Philadelphia Navy Yard of a catapult, turn table, launching platform, by which a plane may be launched into the wind without altering the course of the ship.

Pure Science

Telescope and spectroscope have often made revelations of a more or less sensational nature. It is not always that the announcement to which the lay mind reacts in a manner justifying the use of this term is the one which impresses the scientist as of extreme importance Once in a while, however, an advance is of such nature as to appeal strongly to layman and scientist alike. Such a one is the outstanding astronomical development of the year 1921

Always astronomers have speculated as to the actual sizes of the stars, and always they have had to confess that here was one subject on which they were as much in the dark as the man in the street From the earliest times to the present day, whether viewed with the naked eye, with the most powerful modern telescope, through the eye of the camera, or by any other means which ingenuity had conceived or apparently would ever be able to conceive, the stars showed themselves as mere points of light—the nearest approach we know in the physical world to the mathematician's ideal point, without actual dimension That the stars must be enormously remote to preserve this aspect in the face of larger and ever larger telescopes was sufficiently obvious even before the present generation of brilliant statistical astronomers began the analysis of the skies which showed figures on this matter of star distances. That some at least of them must be enormously massive and, inferentially, enormously bulky to give the combination of distance and brightness which observation revealed was likewise pretty plain But that any direct means of measuring star diameters would ever be provided would, even two years ago, have seemed the wildest sort of a dream Yet today it is brought down to a basis of cold fact, it has been applied to at least two of the stars which we had reason to believe were among the very largest, and the figures which it has revealed for the diameters of Betelgeuse and Antares are by all odds the most amazing which have ever come from the astronomer's workshop. Best of all, as suggested above, these figures and the procedure by which they are obtained and the knowledge which they give are of the utmost import rather than of mere casual interest to the student of the universe about us.

There is no obligation upon him who casts a retrospective eye over the past year to seek out further developments in astronomy to place beside or immediately beneath the extraordinary achievement of the measurement of star diameters. Nevertheless, there is one significant tendency of the present era which has come rather to a head during 1921 and which we do not wish to pass without a word. This is the alliance between astronomy and sub-atomic chemistry and physics—between the macrocosmic and the microcosmic The student of suns and universes has discovered that the man whose business it is to look inside the atom and describe and explain what goes on there is in a position to throw great light upon the making and unmaking of stars and stellar systems. Specifically, his own hypotheses of the past two decades, as to what the colors and brightnesses and spectral conditions of the stars mean in the story of their development, he finds more or less definitely confirmed by the study of atoms and electrons. The physicist and the chemist can now tell the astronomer that the sequence of growth and decay which he has pictured as taking place in the stars makes sense and is in harmony with the behavior of matter And, while they can tell him nothing new in the mere technique of spectroscopic observation and spectroscopic analysis of distant stars, they are now able to tell him much that he has not known about the innermost whys of the spectral lines of absorption and emission and what they tell him makes him the more secure in the conclusions that he is able to draw from his spectra

Another curious instance of the throwing of light by one science upon the outstanding puzzle of another lays us further in debt to the student of the atom and the electron Many methods of estimating the age of the earth have been put forward—scarcely any respectable geologist or physicist but has suggested one of these They all depend upon mere arithmetic, to the extent that we observe some condition like the salinity of the ocean or the thickness of the rocks or the amount of erosion in some deep gorge and calculate how long it would take this condition to be brought about They all are weak to the extent that they assume this process, whatever it be, to have taken place in the past at the rate of its observed occurrence in the present The student of radio-activity now puts forward a phenomenon which, in the very nature of things, must always have proceeded at the same rate, namely, the disintegration of radioactive elements into other elements of lower atomic weight On this basis an estimate of the world's age has been made which seems to be far more rational than any ever made before, and which we can well afford to accept as marking an epoch in the discussion of this problem.

The chemist and the physicist, too, are taking their cue from the student of the atom, so that it seems we may justly call this the age of such study Realization of the extraordinary amount of power locked up in the atom has been with us for some years. But 1921 seems to have put upon a firmer basis of actual expectation the possibility that some day we may be able to put this power to work The problem is being attacked, and the scientist of sufficient imagination to be interested in the big things of the future in preference to the little things under his nose feels no hesitation in predicting that the days of our dependence upon fuel and hydro-generated power and the other clumsy expedients which separate us from barbarism are numbered.

It would be out of place not to acknowledge the fact that much of the success with which we nowadays attack large problems like this one is due to the organization of research and the great resources that are put behind such organization Nowhere has this achieved a greater measure of proved success than in the field of medicine, hygiene and biology Our study of the phenomena of life itself is advancing to a point where we can take living tissue from a living animal and long after the death of the animal from which it has come, keep it alive

Without any wish to minimize the great gulf that lies between a small piece of comparatively homogeneous tissue and the complex organism of the higher animals, the importance of this achievement is such as to make it rank high among the year's announcements Then there is that thing that has, through judicious advertising, taken such a hold of the popular imagination—the possibility that the recognition and study of vitamines will at last tell us why some foods are sufficient to maintain life and others are not. While still unisolated and therefore of quite unknown chemical constituency, vitamines seem to have come to stay, and although much of the work leading up to the present knowledge has been done in past years, 1921 must be recognized as a year of climax and, above all, a year of publication and application of results on a wide scale

A review of the year's developments in the field of pure science would be incomplete without a word about the post war revival of archeology This is now in full swing, particularly in Egypt, but in lesser degree in Mesopotamia, the Americas, Greece Italy, and elsewhere

Electrical Progress

The past twelve months have been truly fruitful with respect to electrical progress. On the one hand the year 1921 saw several large projects completed, and on the other the discovery or rediscovery of electrical principles of far reaching importance

Among the large projects realized during the past year have been the numerous hydroelectric power plants throughout the world. In our country we have done very well indeed, the truth of the matter is that we are fast harnessing our last water-power resources of the first order Very soon our engineers will have to turn to the more difficult and less profitable water powers whose value is not quite so obvious to the present generation pampered as it is through an abundance of natural resources.

Aside from hydroelectric developments on a vast scale, there have been numerous new power houses constructed Owing to the high cost of coal and other fuels, these power houses are models of efficiency and present an interesting forward step over the practice of but a few years back. Still another phase of recent electric power development is the placing of the generating units close to the supply of fuel—at the mine, in a word Thus we have seen the Germans build large power plants at the very edge of their brown coal deposits, for the good reason that the low grade fuel could not be shipped any reasonable distance without costing more in transportation than it is actually worth in heating efficiency In the United States we have also begun this practice of building our power plants at the mines, and transmitting electric power, instead of coal, to the power consumer

It has been a rich twelve-month period for radio communication The huge Radio Central, some seventy miles out of New York City, was little more than an idea at the close of 1920 The end of 1921 saw this station taking very definite shape, with twelve of the seventy-two towers in actual operation The Radio Central, focusing the radio communications of a large number of European and South American countries on New York City, marks a vast stride forward in radio Lesser developments, but none the less interesting and significant have been the increased number of broadcasting radio telephone stations and the new appeal of radio to business men, farmers, professional men and even our good wives who, heretofore, found no interest in the meaningless and monotonous dots and dashes. But now, with the radio telephone transmitters in ever-increasing numbers, a radio receiving set becomes nothing less than a listening in post on a mighty interesting party line

We have followed the promising work of Edouard Belin, the French inventor dealing with transmission of photographs and drawings over wires. In October of 1920, M Belin gave his demonstration between St. Louis and New York But during the past twelve months he has extended his work to wireless, and succeeded in transmitting drawings from Annapolis to Malmaison, outside of Paris, and from Bordeaux to Otter Cliffs, Maine

Other developments have been the interesting 1 000,000-volt transmission experiments of the General Electric Company's Lynn laboratory the work of the two Danish inventors on a principle first discovered by Edison several decades ago, improvements in electric furnaces, and so on

From Steamer to Sailing Ship

A Plea for the Two Hundred Wooden Steamers Built by the United States Shipping Board

THIS article is a brief for the fleet of wooden steamers which were built for the United States Shipping Board to assist in meeting the urgent demands of the late war. It is written in the belief that the action of the Board in ordering these vessels, to say nothing of the ships themselves, has been the subject of much unfair criticism and misrepresentation. So far as the action of the Board is concerned, we must remember that when the ships were ordered the submarine campaign was at its worst, and the call had come from our Allies across the water for "ships, ships, and yet more ships." They asked us to place at their disposal, and to build to the very limit of our capacity, anything and everything that could carry food, munitions, and men across the western ocean. We answered that we would and set about the task at once with all our might. It was an emergency call, we adopted emergency measures.

Why the Wooden Ships Were Built

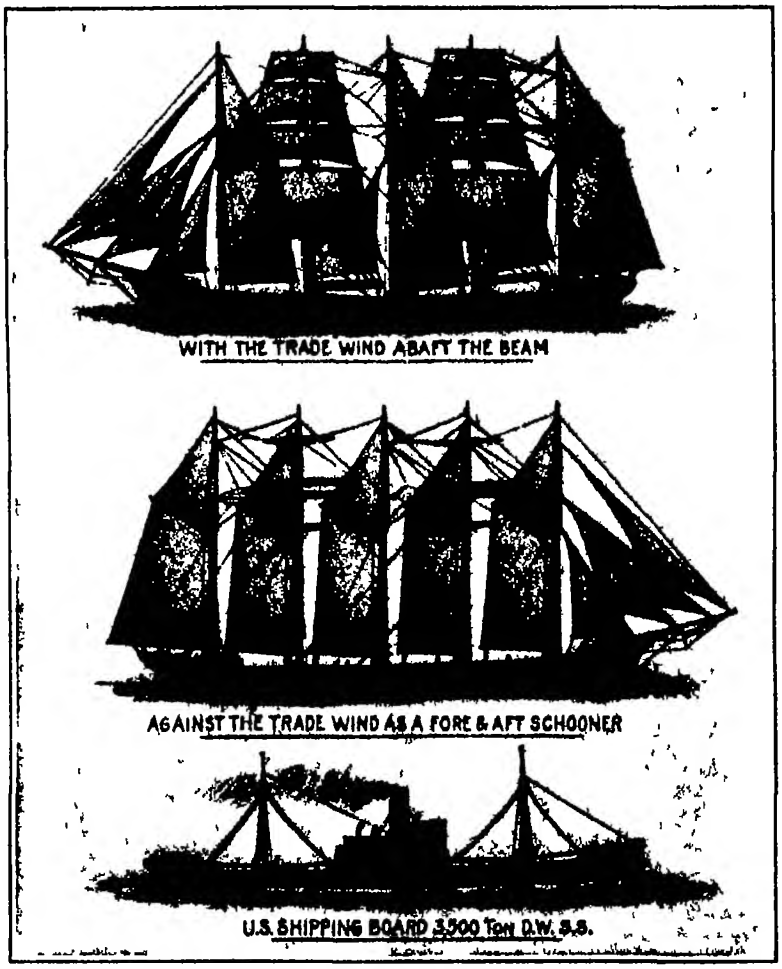
Many responsible critics have asked why in the world, with our vast steel works and our capacity to turn out ship shapes and plates in vast quantities, we should have put so much of our effort into building such out of date vessels as wooden steamships. The answer is that this fleet of ships was additional to the program for steel ships, and that their construction could be done rapidly and without hindering the larger program of construction. The vessels were built for a special purpose and to assist in meeting a great crisis. No one knew better than the naval architects who designed them that wooden ships of 3500 tons carrying capacity if they were driven at 10 to 11 knots by steam power could have only a limited life, but they knew also that these ships would be serviceable for the longest period of time that the war was likely to last. They were well designed for their purpose but if there had been more time available they would have been built with the use of a considerable weight of steel strapping to increase their longitudinal strength.

Green Timber Not a Fatal Objection

Much has been made by the critics of these ships of the fact that they were built of green timber. Well, that was the only earthly way in which they could have been built in the limited time available. Moreover construction of drying kilns capable of handling great timbers that were 12 inches square and from 40 to 60 feet in length would have been a task only less than that of building the ships themselves. The cost, furthermore, would have been prohibitive.

On this subject and others connected with the construction and the present and future value of the vessels we have just received a very informative letter from a naval architect, Mr. Charles I. Nielsen who assisted in the design of these ships and is firmly of the opinion that they have a life of usefulness before them as sailing vessels. The statements which follow are digested from his letter, and we have prepared drawings showing one of these 3500-ton vessels, with its engines and midship deck structures removed and rigged as a five-masted compromise square-rigger and fore-and-aft schooner. Mr. Nielsen, who has had much experience in the construction of both steel and wooden ships, stands behind the statement that 80 per cent of these vessels are "as staunchly built as wooden ships can be," and that if they are given the same care as other wooden vessels, they will be good for twenty years of service. He draws attention to the facts that the American Bureau of Shipping was responsible for their construction, that they were designed by responsible naval architects and that the Bureau did every thing in its power within the limits of time available, to make these vessels as strong as possible for their work. A dead weight carrying capacity of 3500 tons is very extreme for a wooden steamer and the Bureau knew that for various reasons these ships could not last long as steamers. In the first place, they were designed to the ultimate limit of wood construction, for the exigencies of the war demanded that the design should be carried to the very limit in size. With care they would have carried on throughout the war, but they were never intended for continuous service as merchant steamers in after war times.

So far as the use of green timber is concerned, our correspondent says that he knows of no large vessel that has been built of kiln-dried wood. Kiln-drying would have added some ten years to the life of these vessels, but the conditions were such that it could not be done. Our readers will remember that we published pictures of five-masted steam schooners of 3000 tons dead weight, designed by Mr. Cox, formerly of the Construction Corps of the Navy. Although these vessels, forty in all, were built of green lumber, they were no better constructed than the Shipping Board vessels. They have given good service and proved to be well able to stand up to their trying, everyday work.



Lowest drawing shows U. S. Shipping Board wooden steamer, of which some 200 are for sale. Two drawings above show steamer as changed to a five-masted schooner, the engines, boilers, and midship deckhouses being removed

In some respects the Shipping Board's vessels have an advantage, for the schooners were built of fir, whereas the major part of the United States Shipping Board vessels were built of long-leaf, yellow pine, a stronger and more durable wood than fir.

Long-Lived Wooden Vessels

We are informed by Mr. Nielsen who comes from Denmark, that there are vessels on the high seas today that were built of green fir in the Baltic over fifty years ago, and it seems that there are old time war vessels at the navy yard in Denmark that are over 100 years old. These old craft make cruises every summer, and according to our informant, they are good for another hundred years. Of course, the wooden ship has its limit in size, which is about 3000 tons, but by the use of diagonal steel strapping this may safely be raised on sailing vessels to 3500 tons, which is the size of the United States Shipping Board wooden vessels. Used as steamers, the ships would require a crew of 38 men, but if overhauled and rerigged, a crew of 10 would do.

How They Could Be Refitted

It would be a matter of straight shipbuilding work to remove the midship deck structures, leaving the fo'castle and poop. The vessels would be amply strong to carry a five-masted rig. With the boilers and engines removed, they could stow 3500 tons of cargo. Booms and mast could be utilized on the sailing rig, and part of the cargo winches could be retained and a small boiler installed to run them. If the vessel's bottom were given a good coat of boiling-hot brown tar and pitch and a layer of felt and composition covering they would be perfectly serviceable as sailing vessels.

The Compromise Rig

It is proposed to give the ships a compromise rig, providing a full fore-and-aft sailspread for windward work and providing a full suit of square sails on the second and fourth masts. Such a ship would be well suited for the North and South Atlantic trade winds. Going to windward, she could lie up much closer than a square-rigged ship, and down the wind she could show a sail area of 46,000 square feet, as against 32,000 square feet when close-hauled.

Standard Specifications for Large Incandescent Electric Lamps

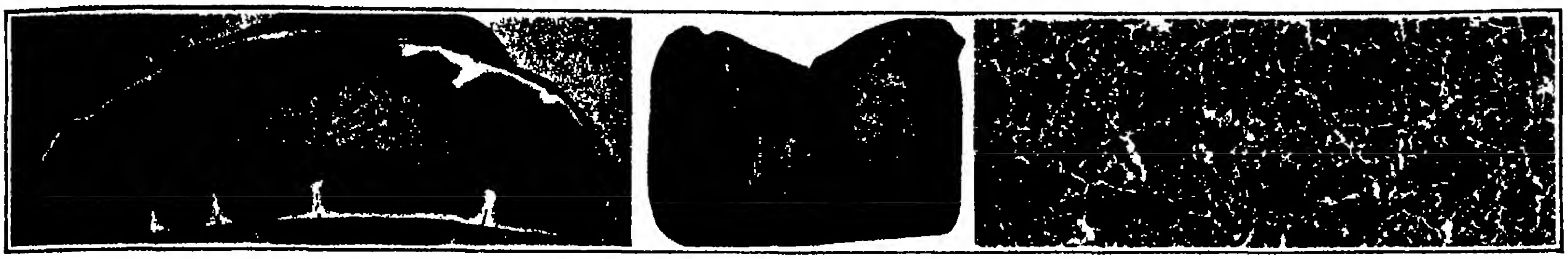
FOR about 14 years electric lamps have been purchased by the Federal Government under specifications published in Circular 13 of the Bureau of Standards. Progress in the art of lamp manufacture has been so rapid that this circular has had to be revised eight times in order to keep the specifications abreast with current developments.

The 9th edition of this circular has just now been published and may be obtained at 5c per copy from the Superintendent of Documents. The original specifications covered only carbon filament lamps while in the later editions metallized carbon and tantalum lamps were introduced and then discarded as tungsten replaced them in use. In connection with these radical changes in types of lamps, very great improvements were made in the efficiency and the life required, but no fundamental change was made in the form of the specifications or methods of testing. However for the fiscal year beginning July 1 1921 new specifications have been adopted which include important changes in the test procedure for tungsten lamps. The most notable of these changes is the abandonment of the long distance provision that the life of test lamps shall be considered as ended when the candlepower has fallen to 80 per cent of the initial value. Now the life is considered as the total life of the lamp since the efficiency of tungsten lamps drops but very little up to the point of burn-out. The performance of a lamp throughout its life will also be taken into account and tolerances are provided to care for possible variations in test results where only a small number of samples of any one order are available.

Tests under these new specifications are intended to give a more complete indication of the performance of lamps than was the case with the former specifications and while prepared primarily for use by the departments of the government in purchasing incandescent lamps, it seems desirable on account of the thoroughness with which the subject has been studied and discussed to make the specifications available for the general public. It is for this reason that they are being used as the 9th edition of Circular 13.

Criticisms and suggestions concerning these specifications and lamp ratings are invited from both manufacturers and users and all such suggestions will be carefully considered in the event of a further revision of the specifications.

While dealing with the subject of incandescent lamp specifications it is perhaps wise to call attention to the article prepared for this issue by Mr. Luckiesh, the well known authority on illumination, which appears on page 27. Illuminating engineering has made rapid strides in a remarkably short period.



Left: Section of burnt file blank showing decarburization magnified three diameters. *Center:* Chill crystals in small steel ingot magnified two diameters. *Right:* Overheated mild steel in section, magnification, 15

Three representative samples of British photomicrographic work of low magnification

With Eye-Piece and Camera

Recent British Developments in Petrological and Metallurgical Microscopy and Photography

By Albert A Hopkins

IN the present article British practice will be considered, because, owing to her insular position England was obliged to depend on her own resources during the war She had to develop her optical manufacture in a phenomenal way, and her scientists led in the great advance of microscopical technique and the technique of photo-micrography At a symposium held in January of last year by the Faraday Society the Royal Microscopical Society, the Optical Society and the Photo-Micrographic Society, the best minds of the world of microscopy and allied sciences came together in a remarkable meeting held at the rooms of the Royal Society Burlington House, London Discussion of these papers took place in various parts of the country and finally they were all republished in the Journal of the Royal Microscopical Society a few months ago

The Petrological Microscope

We shall not devote very much space to the petrological microscope except to show a good example of English make and to give a few generalities concerning the ideal petrological stands gleaned from the paper of Dr J W Evans, F R S The petrological microscope is constructed to serve two purposes It is employed in the first place as an ordinary microscope, to observe the form and structure of the smaller features of rocks, and it is also used as an optical instrument for studying the action of minute crystals on light with a view to their identification The latter function requires special features of greater or less complexity The exact nature of these arrangements depends, however, to some extent on whether the material is examined in the form of a thin section of rock or in minute grains or fragments.

In all petrological microscopes provision is made for the examination of the object between crossed nicols, and for the rotation of these or of the stage, or of both alternatively The advantage of a rotating stage and stationary nicols is so great from the point of view of simplicity of construction that it is always adopted in the cheaper instruments, and it is quite satisfactory in all cases where the work is confined to thin sections and methods involving certain special accessories or arrangements are not required to be employed. On the other hand, for the examination of grains mounted in oil or other high refracting media, the use of a stationary stage and rotating nicols is practically a necessity if high powers are to be employed, unless the Nachet device is adopted by which the objective is attached to the stage and rotates with it Rotating nicols are also necessary for the more complex optical methods, especially those that require an axis of rotation at right angles to the optical axis of the microscope, as when the optical characters of crystals are studied by means of the theodolite or "universal" stage It deserves consideration whether, when rotating nicols are employed, a rigid connection between them should not be substituted for the gearing sometimes employed, even though the former is open to the objection that a rotation through a complete circle is not possible

When crushed material or small grains are examined in oil or micro-chemical tests are applied the microscope should be protected by a shallow glass bath with a plane floor large enough to hold the glass slip There should be a "mechanical stage" providing for the movement of the object in two directions at right angles to each other and to the optical axis of the microscope so that the position of the object may be varied while its orientation remains unaltered These movements and the fine adjustment should be accurately graduated

Arrangements should also be made by which a nicol may be placed in a position above the eye-piece At the same time a slot should be provided at the focus of the eye-piece so that accessories, such as quartz wedges, may be inserted in focus. The upper nicol or analyzer, wherever placed, should be capable of rotation, either simultaneously with the lower nicol or polarizer or independently of it and there should be special facilities for adjusting it at small angles of divergence from 3 to 6 degrees from the position of crossed nicols This is useful in determining the exact position of extinction

Metallurgical Microscopes

Now leaving the petrological microscope proper we come to the all important question of the metallurgical microscope and this subject was admirably treated in the paper by Prof Desch of Glasgow who stated that the use of the microscope in the examination of metals first introduced by Sorby more than 50 years ago has become so widespread that a microscope is now an indispensable item in the equipment of a metallurgical works whilst the recognition of its importance to engineering works and other places in which metals are employed for constructional purposes is rapidly extending It is therefore essential to the conduct of these industries that instruments should be available which will allow of the rapid and convenient examination of such metals as present themselves in the course of routine testing, whilst it is obviously desirable that elaborate and detailed investigation of specimens of special interest should be possible It is quite true that any ordinary microscope of good construction may be used for metallographic work provided the higher power objectives are duly corrected for uncovered objects, but the increased convenience of a properly designed instrument is so great as to justify its use even for routine work There are now on the market metallurgical microscopes of many patterns. Racks should be cut in hard incorrodible metals or alloys instead of in soft brass whilst the pinions might also be of much harder metal than is usually the case It is probable that manufacturers have been too much guided by tradition in the choice of the metals to be used in the construction of scientific instruments witness the tendency only now disappearing, to use highly polished brass for heavy portions where cast iron would serve the purpose equally well

There is no reason why the shape of the medical or biological microscope should be slavishly followed especially when the question of photography is considered The tripod form of foot so convenient in work by transmitted light is awkwardly in the way when examining metals and having occasion to use the rackwork movement for raising and lowering the stage The racks and pinion should be geometrically cut in metal of sufficient hardness to withstand prolonged usage without working loose The body tube should be of wide diameter on account of photographic work A plain stage of fairly large size is suitable for most ordinary work It should be provided with a rackwork focusing movement but a fine adjustment is unnecessary A central hole sufficiently large to allow an objective to pass through it permits the examination of heavy specimens resting on the foot unless the support of the stage be arranged to swing aside entirely Mechanical movements of the stage are essential for high power work, and rotation is also a very great convenience, but when both are provided the rotation should be concentric When a microscope is intended to be used in the horizontal position it is desirable to provide the mechanical movements with clamping screws, as otherwise a heavy specimen may cause a gradual downward slip during the exposure of a photograph plate pulling down the rackwork by its own weight, particularly when photographing at high magnifications. The rotating circle should have a clamping screw The examination of fractures large crystals in ingot sections and other things requiring very low powers and great distances is troublesome when an ordinary microscope is used and it is often preferable to employ a camera with a land scape or copying lens instead of a microscope Illumination of the object has been given great attention in England and every metallurgist using the microscope and every manufacturer has his favorite It is now very generally agreed that short mounts are to be preferred for metallographic objects A high numerical aperture is necessary for the highest powers Oil immersion objectives are of course necessary for the highest magnifications Projection eye-pieces are to be preferred for photographic work

Through the courtesy of F H G Monypenny Chief of the Research Laboratory of Brown Bayley's Steel Works, Ltd we are enabled to give our readers some account of the latest advanced practice along this line Mr Monypenny justly says that while the technique of the photomicrography of metal has advanced greatly during the last ten or twenty years there are still marked evidences that many who take up microscopic work in connection with metallurgy appear to study the microscope itself either not at all or only to a very small extent The consequence is that statements are made about the structures of various metals which are not correct, the presence in sections of minute particles or membranes

Horizontal metallurgical microscope, designed essentially for benchwork

of constituents, other than those stated to be there, has been missed simply because the operator did not know how to use his microscope properly. Again, photographs are published which have only a slight resemblance to the structures photographed, in some cases the definition is so bad that the reproductions are not worth the paper they are printed upon. One has only to look through the journals of, for example, the Iron and Steel Institute to see how true this is.

In his paper Mr. Monypenny has attempted to set out some of the conditions which appear to him to be necessary to secure good photomicrographs of metals and the means he has devised from time to time to fulfil these conditions. The following are some of the points raised.

The Illuminant and Condensing System with Metallurgical Work

Few who have had any experience in photomicrography will disagree with the statement that the illumination of the specimen is of fundamental importance in the production of a good photomicrograph. Good illumination should meet four conditions. The whole surface which is required to be reproduced should be evenly illuminated; the lighting should be such that the whole aperture of the objective may be utilized; the wave-length of the light used should be that for which the objective is corrected; and the wave-length of the light used should be suitable to the color of the specimen.

Fortunately, in most metallurgical work the specimens rarely call for the use of any definite color of light and hence the necessity for complying with the last-named condition does not, in general, arise. This is a great advantage, as it enables one to adjust the color of the light to fulfil the preceding condition. In other branches of microscopic work (e.g., in connection with biology), it may easily occur that the requirements under these two conditions are opposite, and then the photomicrographer has either to use a color for which the objective is not adequately corrected or one which is not best suited to the specimen.

The vertical illuminator color screens, the relationship of aperture and magnification are all very fully treated in the paper presented to the Faraday Society, but the means which Mr. Monypenny took to prevent vibration and ensure short exposure are worthy of more than passing mention.

Reducing Vibration for Photography

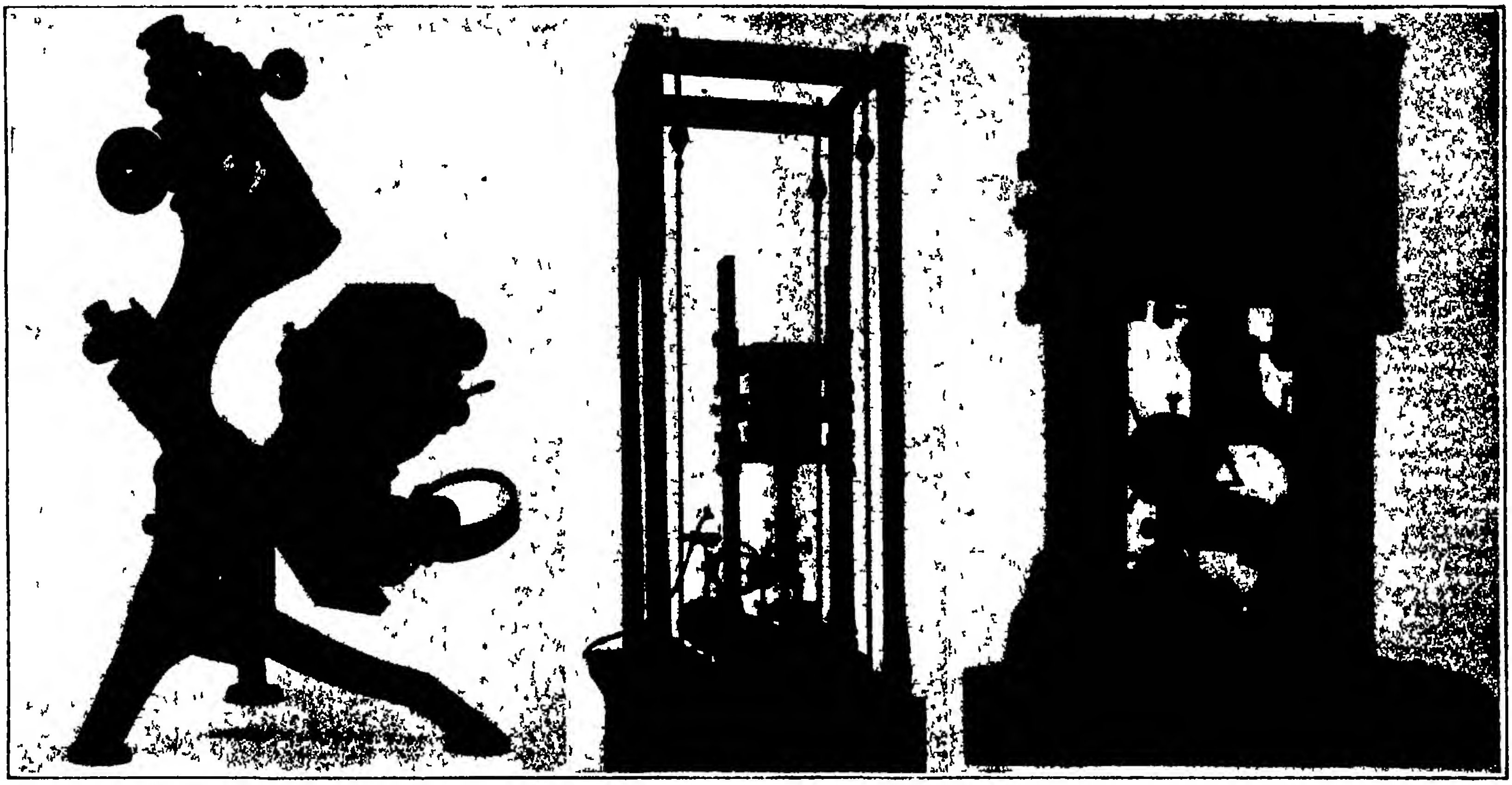
Even when the exposures are comparatively short (e.g., a few seconds), they still give plenty of time in the case of the higher powers for vibration to have considerable effect. He has, however, been able to overcome this completely by swinging the whole photomicroscope on springs as shown. It will be noticed that the author's camera is vertical. This position has several advantages from a works' point of view, obviously it occupies less floor space than the horizontal pattern, and is probably more easily swung than the latter. It may be mentioned that, with the system of suspension used, photographs at 1000 and 1500 diameters were successfully taken although the laboratory was within 50 yards of four 8-ton steam hammers, and also adjoined three sets of railway lines running into the works.

Low-Power Photography

It is frequently desirable to be able to reproduce at low magnifications fairly large areas under vertical illumination. With ordinary low-power objectives (e.g., 2 or 3 inches), it is possible to take photographs at, say, 20 or 30 diameters, but in general the field is only small, about one-eighth or one-tenth inch in diameter. If attempts are made to get a larger field, trouble is at once experienced with the illumination, and often with falling off of definition. Frequently a very large field is required if the photograph is to serve its purpose, as, for example, with groups of flaws, very coarse structures, and segregated areas.

For such work the ordinary low-power objective is not suitable—its "field" is not big enough. The lens Mr. Monypenny uses is the 35-mm. projection lens made by Zeiss, though probably equally good results could be obtained with some of the very short focus photographic lenses made by various opticians. As illuminator he uses a piece of microscopic cover glass 1⅝ x 1¼ inches, mounted in a light brass frame which fits on to the objective. The frame is pivoted, allowing the illumination to be adjusted to a nicety. This disk is used between the objective and section.

The illumination is similar in principle to that used in the enlarging or projection lantern, the condenser being close to the section and focusing the illuminant (after reflection at the cover glass) on to the objective. The condensers used are 2½ inches in diameter, and it is possible to illuminate evenly a section about 1 inch in diameter. For very low powers (i.e., up to 7 or 8 diameters), a short focus photographic lens is used. It is obvious that these low powers are of special value where either the structure is very coarse or one wishes to show the variation in structure over a fairly large area. An American work on metallography will be reviewed in these columns by Mr. Monypenny shortly.



Left: A works metallurgical microscope, after Watson. *Center:* Photomicroscope arranged for high-power work, with spring suspension to prevent embarrassing vibration. *Right:* Microscope and condenser as arranged for low-power photography

The tools of the British commercial photomicrographer

World-Wide Activity in Steam Railway Electrification

DUE apparently to the marked increase in price of fuel which has taken place during the past few years, steam railroads all over the world are studying the possibilities of electrification as a means of lowering operating expenses.

Most of the leading countries in Europe have announced plans either to increase the present mileage of electrified steam railways or to carry out such work where hitherto electrification was not regarded as economically feasible. In South America, Brazil and Chile either have work under construction or are about to let contracts for such projects.

In Asia, Japan and India are both making investigations with a view to electrifying certain suburban or heavy-traffic sections. In Australia, the suburban lines out of Melbourne have been in process of electrification for some years, and other projects in that country are under discussion. In Africa, the question of electrifying steam railways of the Union of South Africa has reached the stage where bids have been invited and are in the hands of the consulting engineers, who are expected before long to place some part of the initial construction contract.

In the past, whenever the question of electrification has been taken up, the matter of increasing the capacity of a section of steam railway has probably been the greater factor, rather than reduction in operating expenses.

It is interesting to note that in many of the larger countries abroad the heavy trunk-line electrification projects in the United States have been very carefully studied and are very frequently referred to by foreign consulting engineers in their reports, and that in several instances standard American plans have been adopted practically complete by engineers advising foreign governments on steam railway electrification. It is believed that the experience of American manufacturers in developing reliable heavy railroad equipment in this country will be of considerable help in negotiating a foreign contract.

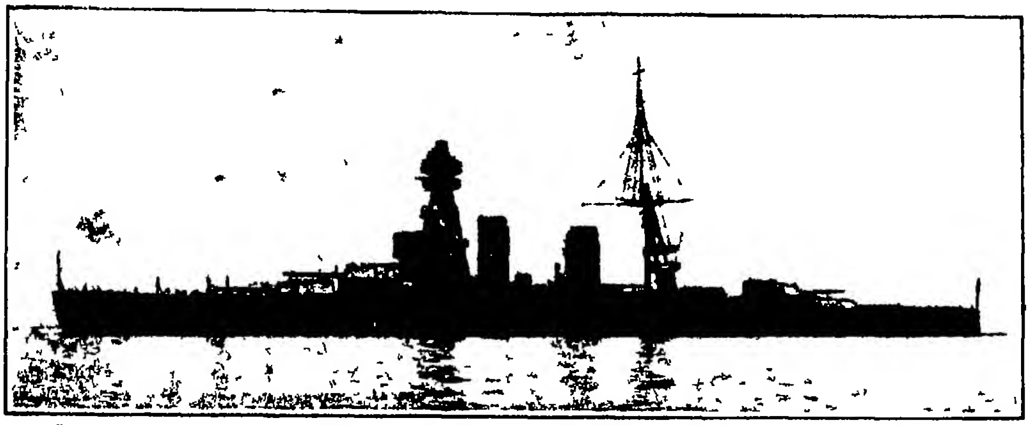
Paper Tile

PAPER from strong fiber containing tannin is soaked in a solution of ammonium sulfate 30, zinc chloride 6, sodium silicate 10, boric acid 10, and water 400, and dried, then painted with a mixture of asphalt 30, coal tar 40, drying oil 10, graphite powder 10, and asbestos powder 10, and finally with graphite powder. It is then rolled and dried.

Naval Construction in Japan

Facts and Figures Regarding the Strength of the Japanese Navy Today and in 1927

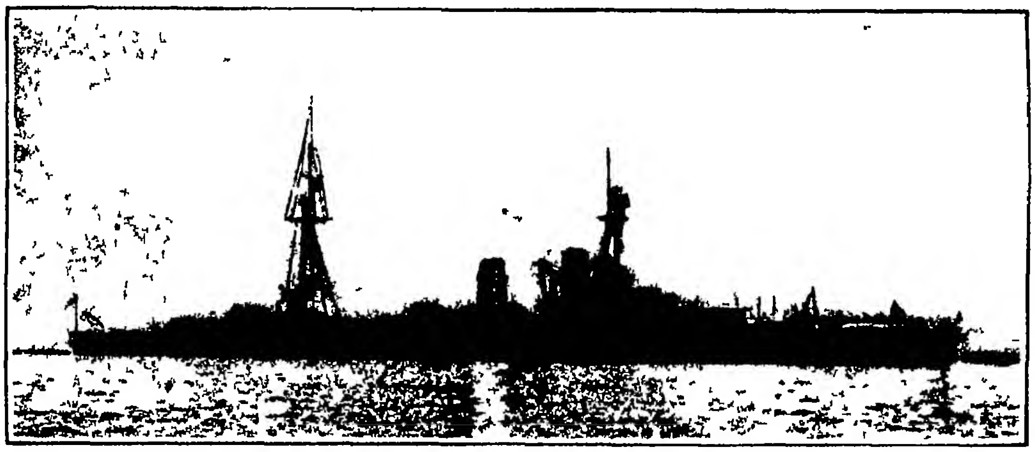
By Hector C Bywater



Battleship "Nagato," also "Mutsu" *Displacement,* **33,800 tons.** *Speed,* **23 knots.** *Armament* **eight 16-in., twenty 5.5-in ; eight torpedo tubes**

THE strength of the Japanese Navy, both at present and in the near future, has become a subject of deep interest to all who follow the trend of world affairs. Thirty years ago the sea power of Japan was a negligible quantity Her navy was scarcely large enough to merit the title, and the fleet that won such a resounding victory at the Yalu River in 1894 was simply a cruiser squadron, though it contained all the effective ships then under the flag of the Rising Sun But the success thus achieved by the young navy gave a great impetus to expansion, and when, ten years later, Japan found herself on the verge of war with Russia, she was able to muster a truly formidable fleet, including battleships, armored cruisers, and other vessels of the most powerful type With few exceptions, however, these new ships had been built abroad, for Japan was not yet sufficiently versed in naval architecture to undertake heavy construction on her own account. In reviewing the development of her fleet since the war with Russia the most interesting fact to be noted is that practically all the ships which post-date that period have been built, armed, and equipped by native industry In some cases, it is true, certain structural parts, machinery, guns, mountings, and armor were purchased abroad, but of late years the import of naval material has been very limited, and Japan, for all practical purposes, is now self-supporting in respect of naval shipbuilding and equipment. Her progress to this position of independence was hastened by the World War, for while that struggle continued she could obtain no supplies from Europe or the United States. She was therefore compelled to fall back upon her own resources, and these were so enlarged during the period of the war that Admiral Kato, the Minister of Marine, was able to announce last year that the whole of the naval construction then in hand would be built and equipped with none but Japanese labor and Japanese material The literal accuracy of this statement is open to doubt, for it has since been ascertained that orders for several thousand tons of armor and a few sets of submarine engines were placed in England on behalf of the Japanese Navy On the other hand, reports that certain capital ships and cruisers of the "eight-eight" program would be built in England have been authoritatively denied.

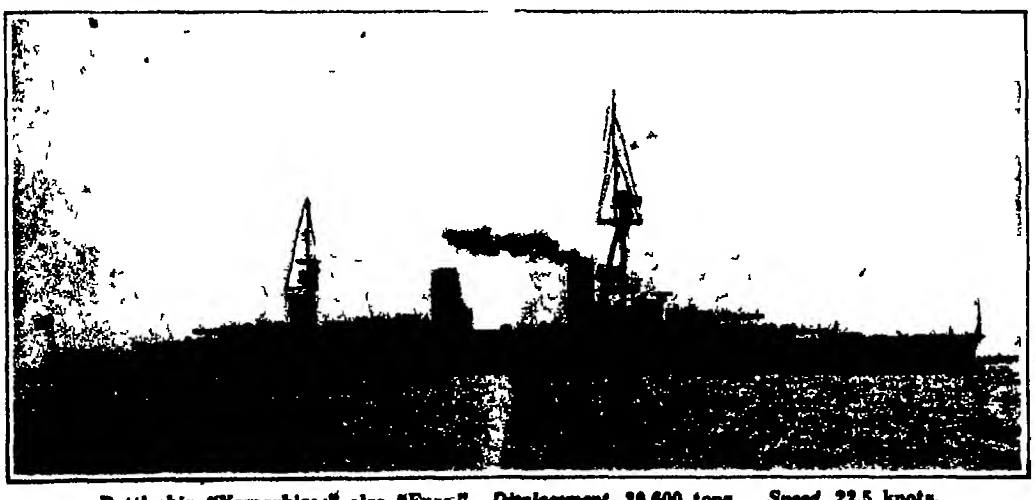
The first large vessel to be constructed in Japan was the "Tsukuba," an armored cruiser of 13,750 tons. Begun in January, 1905, she was launched in the following November and completed in December, 1906, having thus taken less than two years to build—a very notable achievement. In March, 1912, we find Japan laying the keel of what was then the largest and most powerful battleship ever designed. This ship, the "Fu-so," still led the world in respect of dimensions when she was completed in 1915, just as the later "Nagato" commissioned in December, 1920 remains the heaviest battleship—as distinct from battle cruisers—which has been completed to date. By comparison with this rapid development of an industry that barely existed a generation ago the growth of German shipbuilding which used to be considered very remarkable, was a slow and



Battleship "Ise," also "Hiuga." *Displacement,* **31,260 tons.** *Speed* **23 knots.** *Armament,* **Twelve 14 in , twenty 5.5-in ; six torpedo tubes**

laborious process. There are now half a dozen shipyards in Japan which could, if necessary build warships of the largest dimensions. Given the necessary funds and an adequate supply of material, Japan would therefore be in a position to reinforce her navy on a far larger scale than she has done up to now But the present program is already straining her finances to the utmost, and it is very improbable that she will go beyond the "eight-eight" scheme even though the Conference at Washington should prove abortive in regard to the restriction of armaments

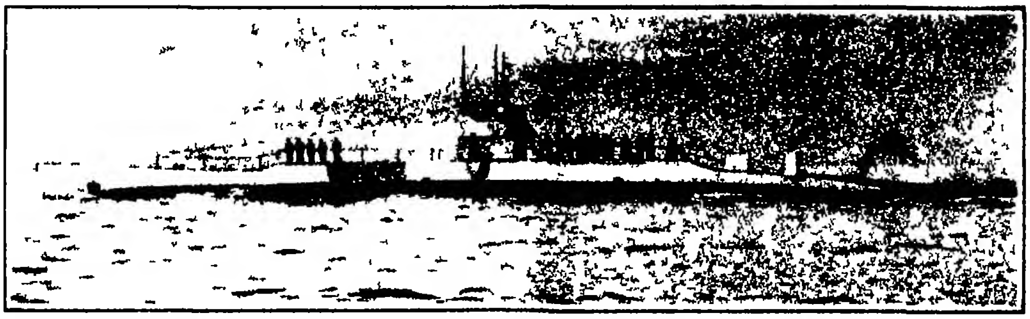
Japan at the present moment is by no means so strong in capital ships as seems to be popularly assumed Her dreadnought battle squadron comprises only seven ships—"Settsu," "Fu so," "Yamashiro," "Ise," "Hiuga " "Nagato," and "Mutsu"—and it is doubtful whether the "Settsu" armed only with 12 inch guns, can be considered a first-class unit The six remaining ships are, however, equal in gun power to any vessels afloat and the "Nagato" and "Mutsu" remain for the time being the strongest representatives of their type in any of the world's fleets. The only other all big-gun ships are the four battle cruisers "Kongo" "Hi yei," "Haruna," and "Kirishima" Powerful though they be, these ships date from the pre-Jutland era, and are especially deficient in protection. They will lapse into obsolescence as soon as the new type of battle cruiser now under design or construction in the United States, Great Britain and Japan comes into service It will be seen therefore, that the Japanese Navy of today includes only eleven ships of the dreadnought type and nearly half of these are or shortly will be, of problematical fighting value The real significance of Japan's naval policy lies not in the size of her existing fleet, but in the scope of her new program which passed the Imperial Diet in July, 1920 This measure covered appropriations for no fewer than fourteen new capital ships, viz. six battleships and eight battle cruisers, all of which are to be completed in 1927 Four of the ships included therein are now on the stocks leaving ten to be commenced between now and 1924 if the stipulated dates of completion are to be adhered to The Japanese naval authorities are maintaining impenetrable secrecy as to the characteristics of all these vessels but since they will be of considerably later design than any warship now constructing in the United States or elsewhere they may possibly prove to be unique in size and gun power If no new American construction is authorized in the interval the completion of the "eight-eight" program will put Japan on an equality as regards post-Jutland ships. In cruising vessels she will enjoy an absolute superiority Ten light cruisers of 25 knots and over have been completed four are building and twelve more have been authorized giving a grand total of twenty six Provision has been made also for an eventual establishment of at least 100 destroyers and from 110 to 120 submarines. The completion of this vast program will tax the Japanese shipbuilding, engineering, and armament industries to the utmost, and it yet remains to be seen whether they are competent to under-



Battleship "Yamashiro;" also "Fuso." *Displacement,* **30,600 tons.** *Speed,* **22.5 knots.** *Armament,* **Twelve 14-in ; sixteen 6-in.; six torpedo tubes**

take and complete so much work during the next six years.

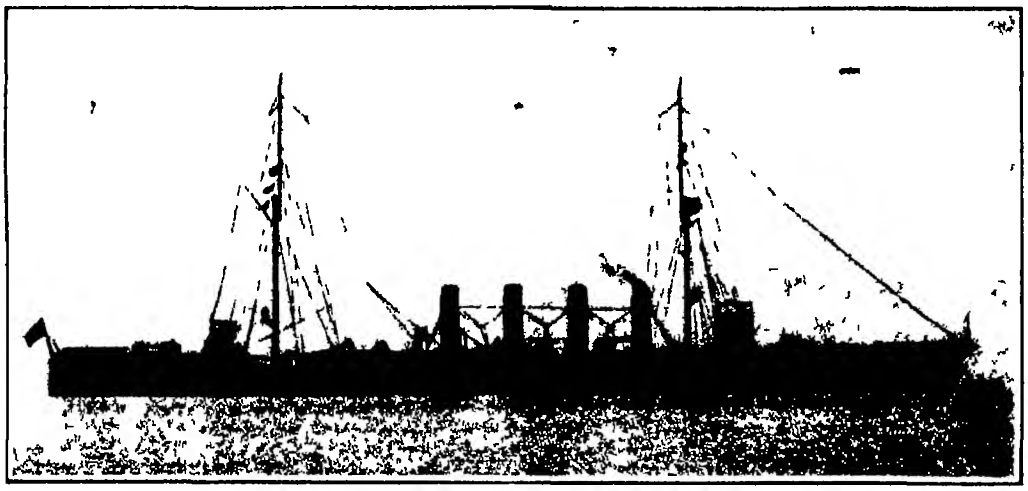
Although no official figures have ever been published it is well known that shipbuilding in Japan is very expensive The battleships 'Nagato" and "Mutsu," of 33 800 tons, are said to have cost $35 000 000 apiece Taking $40 000 000 as a very conservative average for the fourteen capital ships yet to be completed the building of these vessels alone will involve Japan in an expenditure of $500,000,000, and to this must be added the cost of all the new light cruisers, destroyers, submarines, and auxiliaries. No wonder that the Japanese naval budget, which already swallows up 85 per cent of the total revenue, is expected to absorb as much as 40 per cent a few years hence



Submarine "No. 26." Class of eight built 1917 to 1921. ***Displacement,*** **surface, 800 tons; submerged, 1100 tons. Details not available, believed to be generally similar to our own 800-ton boats**

Warship construction in Japan has hitherto developed along fairly original lines. The latest battleships have an armament remarkably powerful in proportion to their displacement The "Ise" and "Hiuga," of 31,200 tons, each carry twelve 14-inch guns in two-gun turrets, twenty 5.5-inch R F guns, and six submerged torpedo tubes. The total weight of this armament is said to be 18 per cent more than that of the U S S "New Mexico' (32 000 tons), whose twelve 14-inch guns are in triple turrets, while her secondary battery is very much lighter, and her torpedo equipment limited to two tubes Moreover the "Ise' and "Hiuga' are 23-knot ships On the other hand, their armor protection is light compared with that of American contemporaries. The "Nagato" and "Mutsu' superficially resemble the U S S "Maryland' class, but they are 1200 tons larger and two knots faster The "Kaga' and "Tosa," laid down last year, are battleships of 39,000 tons, with a main armament of ten or twelve 16-inch guns. The battle cruisers "Amagi' and "Akagi' begun this year and due to be launched in the coming spring, displace about 43 000 tons, with a main battery of eight 16-inch guns, a 12-inch armor belt, and a designed speed of 33 knots. They will consequently be faster and more heavily armed than the 'Hood ' Two further battle cruisers, "Atago" and "Takao," which are to be laid down next January or February, will represent an improved type, and may be the first ships in the world to carry a battery of 18-inch guns It is evident from the public speeches of her Minister of Marine that Japan does not mean to be left behind in the race for speed and gunnery supremacy An experimental 18-inch gun of 45 calibers was completed at the Muroran Iron Works last spring, the breech mechanism having been made at Kure The data regarding this gun are not available

Japanese designers almost invariably aim at concentrating the maximum degree of fighting power in each vessel, whether battleship, cruiser, or destroyer They are reported to have worked out some very novel plans for the new light cruisers, in which a sea speed of 33½ knots is to be combined with a battery of 8-inch guns. Their latest destroyers of the first class are also larger and more heavily gunned than foreign ships of corresponding date. Very little is known about the Japanese submarines. Some years ago the foreign designs from which Japanese constructors had been working were discarded, and plans prepared of a submarine more adapted to the special conditions in which under water craft operating in the Far East have to navigate The experiment does not appear to have been a conspicuous success, for according to recent reports the native constructors have now adopted a design based upon that of the surrendered German U-boats. Among the submarines building in Japan are several very large boats, of 2000 tons or more, with an extensive cruising range and equipped with mine-laying gear In the published illustration of Submarine "No 10' completed last year, above-water torpedo tubes are shown mounted—one on each side of the superstructure In the later boats, of which "No 20" (completed last January and pictured above) is typical, all the tubes are submerged.



Scout cruiser "Hirado," also "Yahagi" and "Chikuma." ***Displacement,*** **4950 tons.** ***Speed,*** **26 knots.** ***Armament,*** **Eight 6-in., three torpedo tubes**

Destroyer "Momi;" class of eight, built 1919-20. ***Displacement,*** **850 tons.** ***Armament,*** **three 4.7-in.; four 21-in. torpedo tubes**

The Determination of Oxides of Nitrogen

THE Bureau of Mines, in the course of its work looking toward the minimizing of accidents in mining operations, has occasion to make analyses of gases in determining the ventilation conditions and the hazards that may develop from exposure of the workers to gases liberated in mines. Not only is it important to identify such gases as form explosive mixtures and are at times liberated in large quantities, but in addition it is necessary to determine what gases have harmful effects upon miners who are exposed to them while at work In metal mines where much blasting is done, the shots are often prepared improperly, and some oxides of nitrogen may be formed after firing Moreover, other industries than mining produce oxides of nitrogen which have a deleterious effect on individuals breathing them for any length of time.

Two gases that result from the firing of explosives are, because of their physiological effects, important in mine ventilation. They are carbon monoxide and oxides of nitrogen Other gases produced at the same time, including carbon dioxide, hydrogen, methane, and nitrogen, are unimportant unless in proportions sufficient to diminish appreciably the oxygen content of the mine air Carbon monoxide and oxides of nitrogen usually occur together and are very harmful, even when inhaled in small quantities. About 0.01 or 0.02 per cent is the maximum quantity of carbon monoxide allowable continuously in mine air without affecting the workmen harmfully, although as much as 0.04 per cent is harmless for periods of time not exceeding one hour Very little data are available on the maximum quantity of oxides of nitrogen that may be tolerated in mine air without danger to the men working therein. The general conclusions are that 0 01 and 0 02 per cent of oxides of nitrogen is dangerous and under no conditions should 0 05 per cent be reached Carbon monoxide can be determined to an accuracy about 0 02 per cent by the usual Haldane analysis, but an accurate method of determining oxides of nitrogen at low concentrations has heretofore been impossible without using a large quantity of gas for a sample

A method was desired by which very small quantities of oxides of nitrogen could be determined from a minimum quantity of gas, for samples of mine gases are taken most conveniently in vacuum bottles of about 250 c c capacity The nitrom method used by Gutbier and Busch is difficult to perform and can not be used at such low concentrations as are present in the usual mine-air samples. To be of value in mine-gas analysis a method should be accurate to at least 10 parts per million, or 0 001 per cent After explosives have been fired, especially in ventilated working faces, the products of the explosion are, of course diluted with large quantities of air, and the amounts of oxides of nitrogen present will usually be lower than 100 parts per million (0 01 per cent) To determine these small quantities, a method was adapted from the usual procedure for the determination of the oxides of nitrogen in water analysis, applying the di phenyl sulfonic acid method to give the total oxides of nitrogen as nitrogen peroxide or as nitrates. By the use of the method evolved, 10 parts of oxides of nitrogen as nitrate could be detected in one million parts of the air oxides of nitrogen mixture with an accuracy of five or six parts per million

New Argentine Floating Dock

THE great variation in the height of the Parana River at different seasons of the year and the cost of keeping the port dredged of the quantities of mud brought down caused the Public Works Department to favor floating docks for the smaller river ports, such as Bella Vista, Corrientes.

A cross-section plan of the new floating dock at Bella Vista may be of interest to American construction companies, as it is typical of all those to be built on the Parana River The plan may be consulted in the Latin American Division.

Recent Advances in Lighting

The Modern Illuminating Engineer: Artist, Electrician, Chemist and Psychologist

By M Luckiesh

Director of Applied Science, Nela Research Laboratory

WHEN the electric light was first being freely introduced into our homes and offices, it was such a startling contrast to the guttering oil lamp and the feeble open gas flame which had been in general use before it, that the public of the late 90's might well have been pardoned for supposing that the ultimate in artificial lighting had been achieved But how mistaken they were will appear to the present generation if we will but take one of the good old-fashioned carbon lamps with the simple looped filament—always supposing that we can find one —and attempt to read by it In the light of present experience with the 50 and 75 and 100 candle-power bulbs that are seen on every lighting fixture of 1921, the "wonderful" 16-candle-power light of 1900 is altogether dim and ineffective, it is surpassed by fully as wide a margin as it in its heyday enjoyed Unless we have actually made this comparison we are apt not to realize what enormous strides the past decade has seen in the art of illuminating Mr Luckiesh, one of our foremost illuminating engineers, tells us in this article of what this advance has consisted and how it has been effected —THE EDITOR.

DURING the past few years the Great War has had some influence upon lighting progress. Developments along certain lines were necessarily curtailed, for the facilities of laboratories were generally concentrated upon war-time problems. There were many developments such as signal lamps, searchlights, and other special devices which have less extensive applications in peace time, although normal activities will profit by them One of the greatest benefits that lighting received from the war was a greater appreciation of the value of adequate and proper lighting in increasing production

In a brief consideration of recent progress in lighting the electric incandescent filament lamp still demands chief attention The luminous efficiency of this type of light-source increases very rapidly with increase in the temperature of the filament and until the limit is reached there will be a diligent search for new filament material or for ways in which older materials can be operated at a higher temperature with satisfactory life No new filament material has been used in this type of light-source since the practical development of the tungsten filament, however, by developing ductile tungsten it was possible to wind the filament into a very small helix with great practical results The filament now possessed, in effect, a relatively much larger diameter which made it possible to operate at a much higher temperature by immersing it in an inert gas, and the resultant gain in luminous efficiency outweighed the loss due to the cooling by the gas. The increase in efficiency was due to the fact that the greatly reduced evaporation of the filament permitted a large increase in the filament temperature Thus with the same filament material the luminous efficiency of the tungsten lamp has been greatly increased in the past decade

It is interesting to note that the output of carbon filament lamps in this country decreased in 1920 to only 4.3 per cent of the total number of lamps made as compared with 7 per cent in 1919 and 97 per cent in 1907 This lamp is now practically extinct in general lighting However great possibilities are inherent in the carbon filament because carbon melts at a very much higher temperature than the metallic filaments which have replaced it. It will not be surprising to find carbon return some day to its old importance in light-production.

Even after the great step had been made from vacuum to gas-filled tungsten lamps many minor improvements have extended the fields and satisfactoriness of the tungsten lamp. By increasing the efficiency and providing a special dense blue glass the tungsten lamp has invaded the portrait studio By a similar procedure an approximation of average day light has resulted which makes this kind of artificial light more satisfactory where daylight quality is best Diffusing glass and coatings have been developed to reduce the glare from bare filaments. Other developments pertaining to colored bulbs, coatings and accessories are extending the applications of light in signs, theaters and elsewhere. By improvements in construction of filaments and by the adoption of a hard glass for bulbs the electric-filament lamp is now widely used for projecting moving pictures and lantern slides. Another conspicuous improvement has been made in the gas-filled lamp for automobile headlights. Careful attention is given to the position of the filament and to its concentration, thereby increasing the accuracy of focusing. Extensive applications of the tungsten filament lamp have been made in a variety of projection apparatus. The highest temperature of the tungsten filament found in commercial lamps of to-day is about 3300 degrees. This is obtained in 900-watt tungsten filament lamps developed for projecting moving pictures. This filament operates at 0 46 watts per spherical candle-power

Incidentally electric filament lamps are now being rated in terms of lumens per watt instead of watts per candle. This is a great advantage because the total output of light can be determined by multiplying the watts by the luminous efficiency The older method of watts per candle did not afford a measure of the total output of light because the intensity was usually given in a single direction or as an average in a certain plane This new method makes it much simpler to solve illumination problems because when the output of the light-sources is known it is only necessary to provide certain factors which represent the efficiency of the lighting unit and the utilization factor for certain combinations of systems of lighting and of reflection factors of surroundings.

The arc-lamp has practically disappeared from interior lighting, and with the exception of the magnetite arc is decreasing outdoors. The magnetite arc is now used in some places for high intensity lighting in the more congested portions of cities The arc-lamp of various special designs has gained ground in moving-picture studios. The Beck arc lamp and modifications of it have greatly increased the beam candle-power of the large searchlights. In this type carbons are relatively small and a blast of alcohol vapor or of air is directed upon the arc This makes it possible to obtain a very small source of light of extremely high brilliancy These two factors are necessary for obtaining powerful beams of light by means of parabolic reflectors The largest searchlight reflectors developed during the war were five feet in diameter In recent years special flame carbons have been developed so that the arc lamp has found some further applications in photography, dye-testing, and other photo-chemical processes.

The low candle-power neon vapor lamp has been introduced in England In principle these are vacuum tubes although the bulbs are generally spherical The candle-power is relatively low for the 110-volt lamps. One neon lamp made in Germany is designed for use with alternating current at one ampere and 220 volts. In order to strike the arc a vacuum interrupter is connected in parallel with the lamp a small choking coil being inserted in the common portion of the circuit An inductive impulse set up by the automatic action of the interrupter by means of a magnetic coil causes a discharge through the lamp This lamp is claimed to operate at 0 5 watt per candle-power, and can be started and stopped as often as 400 times a minute The resistance of such lamps as determined by voltage and current is not fixed, but varies with the intensity of the discharge. A lamp for 20 milli amperes direct current has about 10,000 ohms resistance In general, a consumption of 4 or 5 watts is sufficient for many purposes. Quite a variety of these lamps has been placed on the market in Europe Although this type of lamp is not yet of sufficiently high candle-power to be used for general lighting, its use has been suggested for signs, for emergency lighting, in parallel with a fuse to detect and show burnout, as a position indicator for switches, as a distant indicator of the condition of a motor, and for many other purposes.

Only the usual incidental improvements have been made in recent years on the mercury-vapor arcs. These have not been such as to open new fields for this lamp. The introduction of the quartz tube made it possible to obtain higher luminous efficiency because the quartz withstood the higher temperatures of higher current densities. It has been difficult to seal the leading-in wires into the quartz but recently a method of connecting quartz through intermediate steps of glasses has been developed which makes better seals.

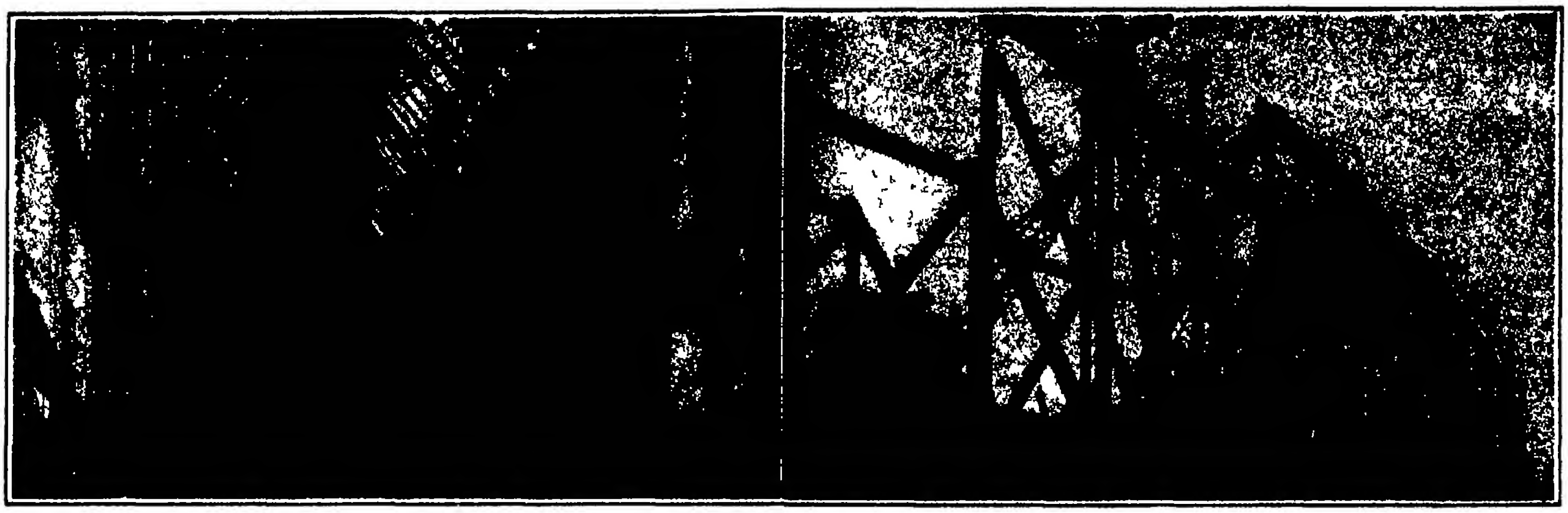
Minor improvements have been made in gas-burners in recent years Very little gas-lighting is entering new residence districts in this country as compared with electric lighting Owing to economies forced upon different countries by the war there have been some gains and some losses in gas-lighting Owing to the oil shortage some time ago, and to other causes, there was a tendency for some gas companies to produce gas of lower illuminating value This led to the elimination of many open burners and to the substitution of mantles. It is surprising that in this age of adequate lighting so many open gas-flames were found In recent years high-pressure gas-lighting has made some headway and considerable progress has been made in automatic gas-lighters and extinguishers and in the development of fixtures Considering the greater difficulties inherent in the gas-burner the developments in gas fixtures are worthy of commendation.

As an example of the changes due to necessity may be mentioned the revival of the old lime-light in Germany In that country, temporary restrictions having been placed upon the use of electricity, the lime-light has been used to some extent for cinema projection The button of lime has been replaced by a disk of rare earths which is heated by an oxygen-acetylene flame The acetylene is produced from calcium carbide and the oxygen by gently heating a patented material sold in small metal tubes enclosed in the ordinary steel bottles.

During the past few years the greatest developments in lighting have been made in the utilization rather than in the production of light In fact the interest displayed in proper and adequate illumination before the war increased greatly in such fields as manufacturing during the war Now in this country the cause of good lighting is again progressing in all its phases In the industries the tendency is toward higher intensities and toward proper reflectors which shade the lamps. Metal reflectors have been well standardized in design and leading manufacturers of such lighting equipment meet the specifications For direct lighting it was also necessary in many cases to equip the bowl of the lamp with an opaque or dense diffusing glass cap in order to eliminate glare from it To eliminate this accessory, leading lamp manufacturers have placed on the market a bowl enamelled lamp This is the first superficial coating to withstand the temperature of the bulb of the gas-filled lamp In factories where an illumination of one or two foot-candles has been common in the past it is now not unusual to find intensities ten times as great

For years lighting was based almost entirely upon the foot candle intensity on a horizontal working plane but with the development of the science and art of lighting various other factors have been given attention Glare reduces the ability to see thereby increasing spoilage decreasing production, and increasing the accidents in the industries. The size, position, and number of light sources determine the shadow effects which are now known to play a large part in visual discrimination The lighting expert now studies the work to be illuminated and determines the desirable intensity of illumination, the character and brightness of the background, and also whether or not local light-sources are to be used supplementary to general lighting However, general lighting of fairly high intensity is the most desirable and general solution It is now realized that the speed of visual discrimination depends upon the intensity of illumination It is perhaps due partially to a general stimulation of alertness in the worker as well as to an increased ability to see The expert also gives attention to the character of the surrounding surfaces, such as walls, desk tops, etc., for if these are glazed they operate to some degree as

(Concluded on page 78)



Left: Inside view of snowshed on Government railroad in Alaska. *Right:* Susitna River bridge, showing the steel span under construction

Examples of the sort of work called for by railroad building in Alaska

Government Railroad in Alaska Nearing Completion

Connecting Seward, at the Head of Resurrection Bay, with Fairbanks by a 471-Mile Line

THE Government Railroad in Alaska connecting Seward, at the head of Resurrection Bay, with Fairbanks, is now approaching completion. The southern end consists of a line that had already been constructed. But the great part of the total main line of 471 miles, the Government has had to build.

The line on its way to Fairbanks crosses the great Alaskan Range, which is really a northern prolongation of the Rocky Mountain System. There are many streams and valleys to pass on the southern and northern flanks of the mighty ridge. Most of these are, naturally, small streams. After passing Anchorage and Matanuska, which are at the sea level and located, respectively, at distances of 115 and 150 miles north of Seward, the road finally abandons the coast and strikes into the rising country. Naturally the line seeks a pass through the mountains, but all the same the slopes go on up to noble heights. The highest elevation reached in the Alaskan Range is Mount McKinley, whose cap of eternal snow and ice rises to a height of 20,464 feet. Mount Foraker, a few miles to the southwest, reaches an elevation of 17,100 feet. These great peaks are no great distance from the railroad in all the region where the line itself approaches its pass over and through the Range. They lie to the left as the road proceeds north, with the Chulitna River between them. The railway track follows the Susitna River, clinging to its eastern bank, from a point perhaps fifty miles beyond Matanuska northwards to the place where finally the river is crossed. This point is some 265 miles northward from Seward. The approach to Mounts McKinley and Foraker is here rather close, though the point of greatest nearness is perhaps a few miles further north. Here, where the Susitna is crossed, is one of the principal features of construction.

That is to say, here is a total of a quarter mile of track carried by bridge and trestlework. The principal section of the supporting structure is a 504-foot through truss span. The main channel lies below.

While Alaska is undoubtedly a land where water freezes readily, we are not to get the idea that the country is a desolate wild where nothing grows and no one can have any joy in living. This is not at all the case. There is a section on the north—occupying perhaps a third of the total area—where conditions are really forbidding, but the southern two-thirds is suited to habitation and to agriculture. Fairbanks is near the northern limit of this two-thirds. Norway and Sweden have many towns further north. The railway will pretty well cover the full north-and-south breadth of the habitable and cultivable section. Seward may be regarded as an all year port, though this can hardly be said of Anchorage.

In preparing to design the bridge, it was found worth while to ascertain the high-water marks and also the ice-scorings on trees. In this way, the probable height of the river itself and the still higher level of the ice-jams could be estimated. Naturally, the engineers had to know what to expect and to locate and dimension the various parts of the crossing in accordance with what the winters and springs would probably bring. This work in a new country, especially a new district like Alaska, presents problems of some difficulty in engineering, because the engineer can hardly determine all the facts, and so has to make allowance for the unknown. The quarter mile of crossing has been divided into seven distinct parts. First, there is, going *from the south to the north, 392 feet of approach* trestlework. This is succeeded by bridge spans of 70, 121, 504, 121 and 70 feet respectively. Then, on the north side comes a short 28 feet of trestle as the road passes from the river onto the bank. On the right hand side of the bridge, the Susitna approaches from the east, while, on the left, it proceeds in a generally southerly direction to the point where it debouches into Cook Inlet.

There is, naturally, plenty of ice in Alaska, especially in the winter time. And quite a lot comes down the Susitna and passes the site of the bridge. It is said that the ice break up in the spring occurs before the ice has softened. Great pieces of solid ice swing down the river, jamming themselves into islands, bars and shore as the stream makes its turns. The ice piles up and restrains the river. The water level rises and this results in increased pressure against the ice jams. After a time the ice may yield and then rush on to get into another jam farther downstream. The question the engineers had to face was what would happen to bridge piers exposed to jams and rushes. They probably gave but little attention to the possibility of using timber piers. Concrete, it seems, was thought hardly certain to be equal to the job of withstanding perfectly the scouring action of an ice-jam against the pier. Such action would not be confined to points above the water but to points perhaps all the way down to river bottom. However, concrete piers were decided upon. By making them massive enough, they may be made equal to anything. Two spans for the main channel of 250 feet each were considered in competition with a single 504-foot span. The former would have required not only three piers, but one would have been near the center. Moreover, the cost was slightly less for the single span. This is an all-steel structure, and was completed in February, 1921. That is, the span was swung on the 2nd of that month and a train passed over on the 6th.

But the whole bridge has not been constructed of steel. Timber has been used on all approach spans. However, the main piers have been designed to sustain 200-foot steel flanking piers, the idea being that in the future such piers could be installed in place of the two combinations of a 121- and a 70-foot span of timber. The reason for the use of timber for truss spans was the high price of bridge steel at the time.

In designing such a bridge, the engineers must take into account the effects of the wind on the bridge and also on a train on the bridge. The stresses on parts of the bridge and on the piers themselves will be modified by a wind blowing against train and bridge. Such wind pressures as 40 pounds per square foot of exposed area are taken into consideration.

It has now become approved practice for engineers to test soil and rock on which supporting structures like bridge piers must rest. This is done before, and sometimes continued during, actual construction. It enables the engineers to know in advance what is to be expected. A site thought to be very favorable for a pier might, upon carrying out a series of test borings, be found quite unsuitable. Borings cost a considerable amount, but they give a certain guarantee against disagreeable and costly surprises that is deemed worth the price. Test borings put down 60 and 70 feet here in the bed of the Susitna River showed that the underlying strata consisted of compact sand, gravel and big boulders. The situation was judged of such a kind that the sinking of piles beneath the foundation layers of the piers would be unnecessary.

Track construction had not yet reached the site of the bridge, but was still a score of miles to the south when, on May 22, 1920, the work on the piers was started. This was too early in the year to permit supplies to be brought over the interval by boat, so for a time dependence was put upon sleds. When the river at last was free of ice, boats were employed over the

Constructing the snowshed: the bents are bolted together on the ground and hoisted in place with a crane

water route (the Susitna itself) and wagons on the land. By September, however, the advancing track reached the immediate vicinity of the crossing, and transportation troubles sank to a minimum. The south pier had then been finished and the north pier was begun.

Some hundred feet downstream, a temporary trestle was put across the river and track laid on it. This permitted the movement of freight not only to the south side of the river, but to the north side as well. So, then, while pier construction was going on, the track was pushed on north.

Difficulties are often encountered in excavating for the foundations of large piers. The layers of earth are apt to be permeated with water under pressure and even the rock may contain fissures filled with water under a head. Besides, the river itself may flow over the pier site. There are a number of methods of attacking the problem. Sometimes a wall is constructed all round the site or so as to connect with the shore upstream and downstream and thus effect an inclosure of the spot. This inclosing cofferdam is made more or less watertight and the contained water pumped out. By the use of pumps to keep the water entering through leaks and the like from giving trouble, the excavation is carried on and the pier constructed. This is a method of dry construction. It was employed in connection with the south pier. The wall consisted of Wakefield piles. These, when suitably driven, create a wooden diaphragm everywhere interlocked. The Wakefield pile seems to be an American invention dating back many years. A typical unit may be made by spiking three planks of equal width together. The outer planks are set exactly opposite each other, but the center one is displaced perhaps two or three inches, though kept parallel. The unit will then have a tongue on one edge and a groove of identical size on the other. By driving such units one after the other, with the tongue of the new pile in the groove of the pile last driven, a continuous wall may be created that is already more or less watertight. It is a very useful device, and has been in considerable use in the past. The interlocking steel sheet pile is now perhaps driving it out of service. The steel substitute can be made tighter and can be driven to much greater advantage because of its superior strength and the knife-like edge on the bottom. However, the engineers used the Wakefield pile at this crossing in Alaska, possibly because timber was near and relatively cheap. On the other hand, steel sheet piles may usually be pulled out and used again and again, so that the actual expense on one job is much reduced by the salvage value.

In concreting the piers, difficulty was experienced from more than one direction. Often, engineers seek to get the small rock used in concrete from some nearby gravel bank. Sometimes, the relative amount of intermingled sand is just what is wanted for the concrete mixture. If there is no foreign matter present—that is, nothing but bare sand and bare pebbles—then the gravel-bank is a kind of treasure. At the bridge site, there was a gravel bank, with intermingled sand, though the sand was deficient in amount. This was naturally something that could be corrected. Nevertheless, there occurred a partial failure of one of the piers during construction. The failure was due in part, it appears, to the presence of humus on and among the pebbles.

The strength of concrete depends upon the cohesion of the constituent particles. Sand particles, cement particles, and pebbles, in themselves, are likely to have satisfactory cohesion, but where the joints among these occur are locations of possible weakness. The cement constitutes the only binding agent. It should cover the entire surfaces of sand particles and pebbles. Where it is absent, there a weak spot will occur. Loam, humus, or any material weak itself in cohesion would be an injurious ingredient. Pockets and films of such material break up the continuity of the cohesion and thus tend to destroy its strength. At any rate, the partial failure in one of the piers was attributed to poor cement, humus and low temperature.

The cofferdam was unwatered, which automatically put the bottom, consisting of porous material, under a 22-foot head of water. Apart from friction, this meant an upward pressure over the bottom of 9½ pounds per square inch. It was found to be practically impossible to partition off the space and place concrete against the pressure. In November, the water was almost to the freezing point and the area to be covered was large. To use piping or buckets and place the concrete under water seemed out of the question. It was, accordingly, determined to deal in a special way with the conditions. That is, the space was housed in and, by means of steam coils, made warm. Even the sand and gravel were heated on platforms beneath which coils were placed, and the water for mixing the concrete was also heated. Concrete was put in place under these conditions during a period when the outside air varied from 2 deg below zero to 48 deg above. At the north pier the temperature conditions were still more unfavorable, the readings varying from 12 deg below to 34 deg above.

That Alaska is not necessarily an impossible place to live and work in during the winter may be illustrated from the fact that the 504 foot span was erected and swung in the period November 8, 1920—February 6, 1921. Riveting on one day was done when in the morning the temperature was 42 deg below zero and 12 deg below at quitting time. It is said that rivets driven during very severe weather were given a retesting a number of times later on when the weather became warmer. The timber work was all completed by February 16, 1921, and the whole made ready by that time for regular service.

It will be gathered perhaps from the foregoing that the Government is pushing its railroad on seeing that winter did not interrupt work high up near the pass through the mountains. In fact, as it is stated under date of August 26, 1921, through traffic is now established from Seward, the southern tidewater terminal, to Hurricane Gulch at mile 284. Also, the branch line from Matanuska is now open to Chickaloon. There is still a gap on the main line between Hurricane Gulch and Healy—that is between miles 284 and 358. It is hoped to close up this gap of 74 miles by spring, 1922. A steel arch which is to carry the line across Hurricane Gulch was already well advanced toward completion at the August date given. From mile 358 to Fairbanks, the road is completed with the exception of a long steel bridge which is to cross the Tanana River at Nenana (mile 411). In fact, this northern part of the main line is already in service, the passage over the Tanana River being made by ferry. In short, by the summer of 1922, it will probably be possible to travel over the entire line from Seward to Fairbanks, with the possible necessity of using a ferry at the Tanana River.

The proper term to use in connection with the entire line including its branches, is the Government Railroad in Alaska.

Rebuilding French homes with bricks of slag made on the spot

Home-Made Bricks in Devastated France

FOR the construction of houses in the devastated region of France, a material is required which shall give high economy. In high present favor at the moment for this purpose is the agglomerate brick made on the spot. Slags and metal dross of all sorts are available, and with any of these substances it is possible to make admirable bricks with the aid of heat. These materials are common enough, and are employed very largely in the manner shown, our photograph indicates the simplicity of the manufacture of this sort of brick.

The prerequisites are a semi-plastic mortar of the proper proportions, the slag and a source of heat. Then the mixture is introduced into the mold, in several installments, the pestle meanwhile being gently operated to pack the material well against the walls of the mold and insure properly formed sides, edges and corners in the finished brick. Once the mold is filled and well packed, the upper surface is evened off by scraping with a flat board. Then the brick is left to set, and is ready in a few hours to be removed from the mold. After removal, the brick is left in the open air until drying is completed, after which it is put in its final place in the wall without further ceremony. The houses constructed in this unusual fashion are reported to be standing up very well in use.

Track Laid on Cables While Fill is Being Made

UNIQUE construction methods were found necessary in building the "toes" to the Taylorville Dam as part of the flood prevention work of the Miami Conservancy District. Instead of spending considerable time and money in building a trestle to carry the tracks, it was decided to suspend the tracks on heavy wire rope. The river surface was about 20 feet below the high bank from which it was necessary to run the trains out. At the beginning of the work there was almost 10 feet of water in the river and 15 feet of mud before striking the gravel foundation.

Four lengths of cables were used, each being 582 feet long. The two inner cables were placed three feet apart, the two outer cables 12 feet apart. Ties were placed on these cables, each third tie being long enough to catch the outer cables. The tracks were then laid on the ties. Each cable was fitted with special bridge socket and take-up for adjustment. The equipment was in use about one month, and during that time the take-up of the cable did not exceed 15 inches.

Great care was taken in backing the loaded trains out on to the suspended track. As soon as a loaded car reached the edge of the embankment, it was dumped and then pushed on empty. This plan kept any excessive weight off of the suspended structure. The rock thus dumped displaced the mud and shut off the flow of water before the fill was half across the river.

The cables stood the work so well that after the job was finished they were put to use as swinging cables on steam shovels.

In making this fill, the expense of a trestle was saved by running the tracks across on a pair of suspended cables

Noises for the Movies

How Various Realistic Sounds Are Produced by Means of Ingenious Drummer's Traps

By Albert A. Hopkins

IN Verdi's celebrated "Anvil Chorus," we have an imitation of the auditory effects produced by the blacksmith when he hammers on his anvil. When appropriate standard instruments are used, many will doubtless have no difficulty in imagining that they hear the hammer strike. The composer, however, was limited by the fact that other things had to be cared for besides giving a suggestion of realism to his music. Among the traps of the drum section of an orchestra is a little instrument which may be used to deal with the matter of imitation with a still closer approach to reality. This is the "anvil," and it consists of two parallel steel tubes of unequal length mounted on a small base. The tubes are 1⅝ inches in diameter, and give two notes, one from each tube. Here the true anvil is imitated by an instrument of substantially the same material as the thing imitated. The form, though, is quite different.

How to imitate simply and effectively, the many sounds suggested by activities represented in motion picture presentations, is a matter of interest. The exhibitor knows that, if the vision of the prowling lion can be accompanied at critical moments with a realistic roar or two, the audience will be much better entertained and thrilled than if the picture were allowed to pass silently. The heroine is held by her enemies, but the rescuing hero is fast approaching on horseback. If the regular thud, thud of the coming horse can be rendered true to reality then an added satisfaction will be given to what the eye sees. Such audible accompaniments have been successfully used upon the regular stage, so one need not wonder that moving picture people are following this lead. In fact, we may expect a greater development of the imitation of sounds on behalf of the "movies," because such sounds are urgently needed to intensify the effects produced by the pictures.

The imitation of definite sounds—musical notes—may be put upon a scientific basis. In the nineteenth century prolonged investigation showed very conclusively that the *quality* of a sound, as distinguished from its pitch and intensity, is dependent upon the combination of simple sounds which go to make up a composite effect. A simple sound may be defined as one which can not be divided into others. It may be said to have no especial quality. The sound produced by the tuning fork may be classed as simple. Perhaps a musician specially trained may be able to detect in an ordinary musical note not only a predominant pitch, but one or more subordinate ones. Ordinary people hear the note as a unit. Nevertheless, ordinary people distinguish quality.

A cornet sounds B flat in the octave above middle C. The ordinary person has perhaps, no difficulty in distinguishing the quality of the note from the note of the same pitch made by the violin. There are, in both cases, subordinate notes which sound simultaneously with the B flat. The quality of the composite tone will depend upon what these others are. Perhaps the musician specially trained may succeed in naming them, the ordinary person would certainly fail. But, it is possible to approach the matter differently, and give the ordinary listener a better opportunity. If, indeed, the generality of musical sounds are composites made up of combinations of simple ones, then it should be possible to synthesize simple sounds and get the composite effect. The B flat on the cornet should be producible by a proper assemblage of simple sounds of various pitches and perhaps of various intensities. This is just about what modern science claims.

With so many sounds desired by the movies, it would be impracticable to produce the imitations in this way. Greater simplicity is required. This is especially the case where the sound is not only composite at a given moment but variable from moment to moment. Advantage is accordingly taken of the circumstance that it is often possible to find a natural material which will produce when vibrated the composition of simple sounds desired. In some cases, the variation required in a prolonged and varying note or series of notes may be obtainable by manipulation of a source of sound. But these methods of utilizing various sound-producing materials, while very valuable at times, do not always quite equal requirements. There is something defective here and there in the imitation. The scientific method of putting sounds together might be called in at this point and made to perform the service of determining just what is lacking or just what is overdone. The procedure might be somewhat as follows.

The instrument used to produce the lion's roar may, perhaps, not quite do the trick at some portion of the rendition. The problem here may probably be solved by determining just what combinations of pitches and intensities produce, at this juncture, the perfect roar of the real lion. These could then be tabulated. Next, a determination would be made of the exact components of the defective sound, and these listed. A comparison of the two statements would then disclose the fault, and possibly suggest its correction. If something additional is needed—say, a simple sound of such and such pitch—it may be supplied. If, however, the imitating sound contains too much, the problem would seem more difficult to solve. What I am suggesting is a scientific method of determining why an imitation is not quite successful. The whole sound may be built up by providing the proper composite of simple sounds, or, sometimes more easily, by assembling together smaller groups. If the variations from instant to instant are not difficult to manage, the whole sound—as, perhaps, a lion's roar—may be rendered with some fidelity. Thus, if the lion's roar were scientifically investigated and its components precisely determined and set down, one might perhaps see at once that certain notes of a pipe organ would give a very good rendition. Or, the simultaneous utterance of a certain note by this instrument of the orchestra, another certain note by that instrument, and so on.

However, the business of supplying instruments which may be used as sources of imitative sounds has been developing. The tubular substitute for the anvil has already been mentioned. A metallic sound is here imitated by a metallic sound produced by a similar metal. The lion's roar is produced by an instrument on the market. This consists of a shell closed at one end and open at the other. Several hoops surround the shell, one of them securing the diaphragm closing the one end. This diaphragm is a membranous affair. It is set in motion by a string through the center. The shell is considerably smaller than an ordinary wooden water bucket. A smaller but somewhat similar affair produces a sound imitative of a dog's bark.

Note now this. These animal cries are produced by the vibration of animal material similarly to the anvil sounds by the metal tubes. Our previous discussion prepares us to understand what is probably a basic fact here. The tones and overtones of which the animal membrane is capable are doubtless similar to those which make up the lion's roar and the dog's bark. All that is needed may be the shells to inclose a body of air that may be set in vibration. A small affair of a similar character, but with the string passed in and out again through two holes near the middle of the diaphragm to form a closed loop, constitutes an instrument with which the locust or the frog may be imitated. A stick is passed through the loop and the shell whirled round. A steamboat whistle is reproduced by using a kind of triple whistle with the parts differing discordantly from one another. A clog dance may be rendered so far as sound is concerned by operating two long handled mallets as if they were the feet of the dancer. A police rattle is really a kind of rattle. A wooden arm may be whirled round the end of a short handle held in the hand. A tongue of wood is secured near the outer end of the arm and projects back to a cog wheel on the end of the handle. The end of the tongue in passing round the cogs, as the instrument is whirled, produces a strong rattling noise. A steady beat of a horse's hoofs upon a hard and sounding road may be imitated with a pair of cups which are struck, open end to open end. The dull, hollow-like sound gives the *thud thud*. Another instrument imitative of a horse's hoofs consists of two pads or flat cushions which may be struck by two long sticks. A horse galloping over pavement or sod may have his foot falls imitated by strokes delivered on the pads. This same device may be used for a slap in the face, shots made by rifles, or pistols, surf effects, etc. By means of a toothed wheel arranged to turn and let a tongue fall from tooth to tooth as the wheel is rotated, the suggestion is made that a windlass, crane, derrick or the like, is being operated. Here, what we have is a partial duplication of some of the apparatus the sound of whose working is imitated. Another device provided with a tongue permits one to imitate the *click click* of the typewriter or telegraph sender. A self-loading pop-gun enables the operator to imitate the popping of champagne corks.

It will be noted, perhaps, that in some of the foregoing cases the imitative device is really more or less a duplication of the thing imitated. Another example is where an automobile horn is imitated by what is essentially such a horn.

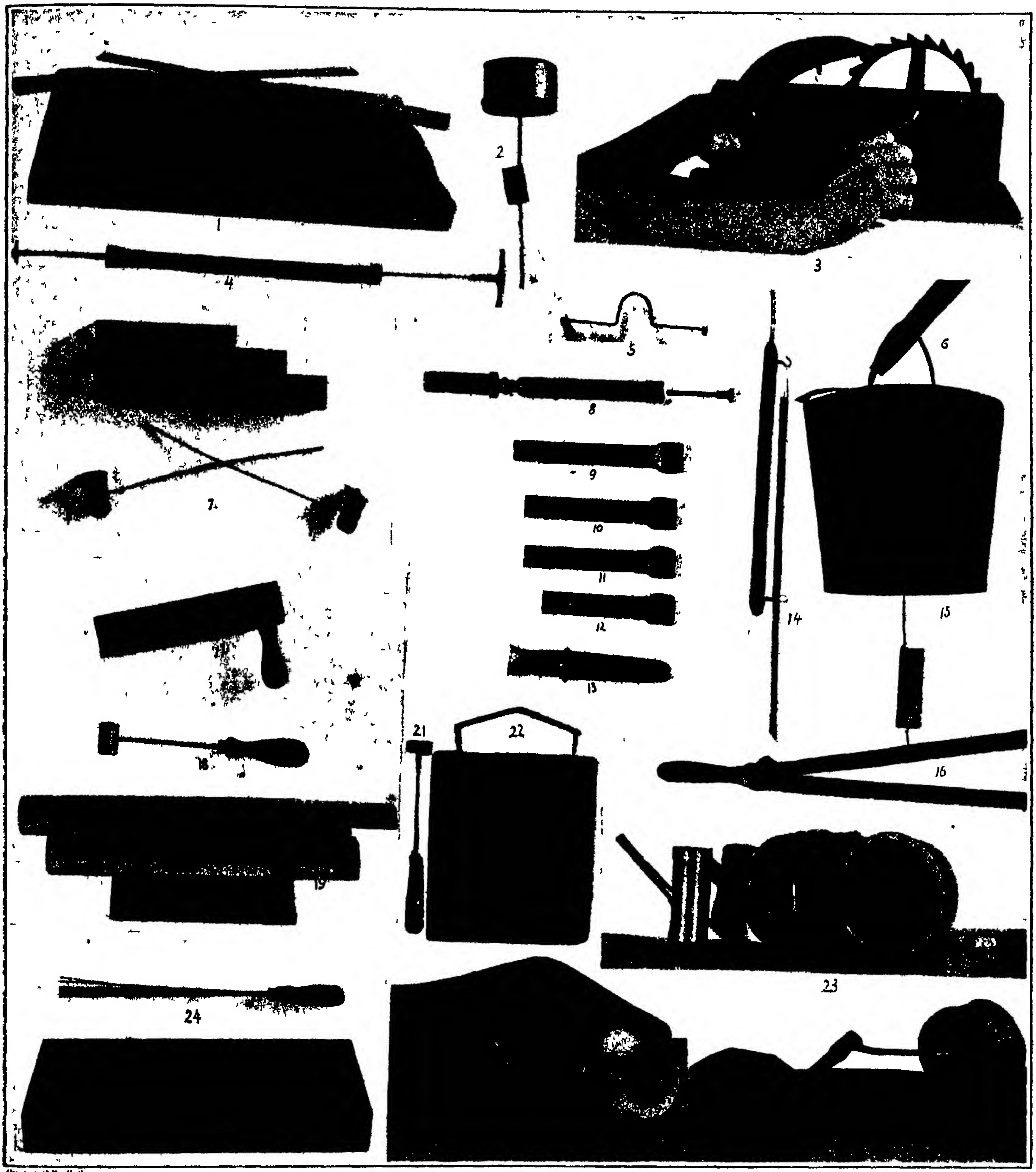
As to the application of such devices as those under review, the moving pictures would seem to offer a wide field that has so far only been entered to a small extent. Apparently, we are still to await a successful combination of the moving picture machine and the phonograph—the talking movies. At the same time, something less is possible, and that is a well-developed and accurate reproduction of the proper sounds at all points where such sounds would increase the realism of the activities visually represented on the screen. Of course, the thing might be overdone, especially if the sounds are but crudely imitated or are exaggerated too much. A good deal about the movies is already a joke. An addition will not help them. But an adequate, accurate study of the possibilities might tend to break the silence to better effect than the usual rendition of music through the performance.

The phonograph is the great imitator of all kinds of sounds and it might enter into competition with the so-called "drummers' traps." But anything like hanging fire when the sounds are needed would result in ridicule. Piano, organ or orchestral music, if strictly appropriate and reasonably responsive to the changes in mood of the story being depicted, is by no means an ineffectual thing. First rate imitative devices—that is, high-class drummers' traps—used at critical moments provide an additional feature tending to intensify interest.

Large Diesel Engines

THE paper read by Sir James McKechnie before the Engineering Conference of the Institution of Civil Engineers serves to focus attention on the design of large marine Diesel engines of 1,000 b.h.p. per cylinder and upwards. The problem is perhaps not so important as it is sometimes thought to be, for no fewer than 90 per cent of the ships afloat are equipped with machinery of less than 5,500 i.h.p. and a standardized twin-screw Diesel plant of this power is now constructed by many engine-builders. Nevertheless, the question of the production of six-cylinder oil-engines developing 6,000 b.h.p., or even 12,000 b.h.p., will always attract designers, and Sir James McKechnie gave some details of the largest single-cylinder unit that has been built in Great Britain. It was built some time ago at Barrow as an experimental two-stroke model, with a bore of 30 in. and a stroke of 36 in., and under test a power of 1,042 b.h.p. was developed at 141 r.p.m. The fuel consumption was remarkably low, being under 0.40 lb. per b.h.p. hour when using the Vickers system of solid injection. It was a single-piston engine with scavenging valves—a design that would not be considered suitable at the present day for high powers since the opposed piston type and the employment of ports instead of valves have come into general favor.

In this connection it may be noted that by the adoption of opposed pistons much smaller cylinder diameters can be utilized to give the same output, for instance, the 4,000 b.h.p. Cammellaird Fullagar engine, with four cylinders, which is now under construction, has a cylinder diameter of only 26 in. and a rotation speed of 90 r.p.m., against 141 r.p.m. of the Vickers engine. It is, indeed, doubtful whether the double-acting two-stroke Diesel engine can be built with smaller cylinder diameters than those of the opposed piston type of equal power, either of the Cammellaird Fullagar or Doxford designs. It is worth nothing that the builders of the latter type hope shortly to be able to manufacture their engines to develop 6,000 i.h.p. (or over 5,000 b.h.p.) in four cylinders. In Germany double-acting two-stroke Diesel engines are now being built for installation in mercantile ships developing more than 1,000 b.h.p. per cylinder, so that before long some interesting developments may be anticipated in oil engines for passenger liners.



Courtesy of Mr. H. Gerson

1 Slap pad, which imitates the galloping of horses on sod and pavement, rifle shooting, pistol shooting, slap in the face, and so on, also surf effects and all others that are done with a sand board. 2. The bark of a dog is here produced by jerking the little pad along the string. 3 Turning this toothed wheel produces such sounds as the action of a windlass, crane, derrick, heaving the anchor, and ferryboat entering slip. 4 Self-cocking pop gun which supplies the "pop" for champagne bottles of the screen. 5. Double hammer for hitting plate shown below at 22. 6 Lion roar or bear growl. 7 Clog mallets with jingles and flexible handles. 8. Whistle of changing notes to imitate certain birds. 9 10 11 12 13 Whistles of various kinds to imitate barnyard noises and birds. 14. Locomotive bell. 15 Pad which is pulled along rope to operate skin of bucket that produces lion's roar. 16. Slap stick. 17 Rattle for all manner of sounds. 18 Hammer for the anvil. 19, 20, 21, 22. Bell plate and one of the hammers. The other hammer appears above, at 5. 23 Whistle that imitates bird calls, and pair of "cocoanuts", which imitate horse-hoof sounds. 24 Imitation of steam locomotive. 25 "Squawker", which serves for many purposes, such as tearing of cloth. 26. Locust or frog

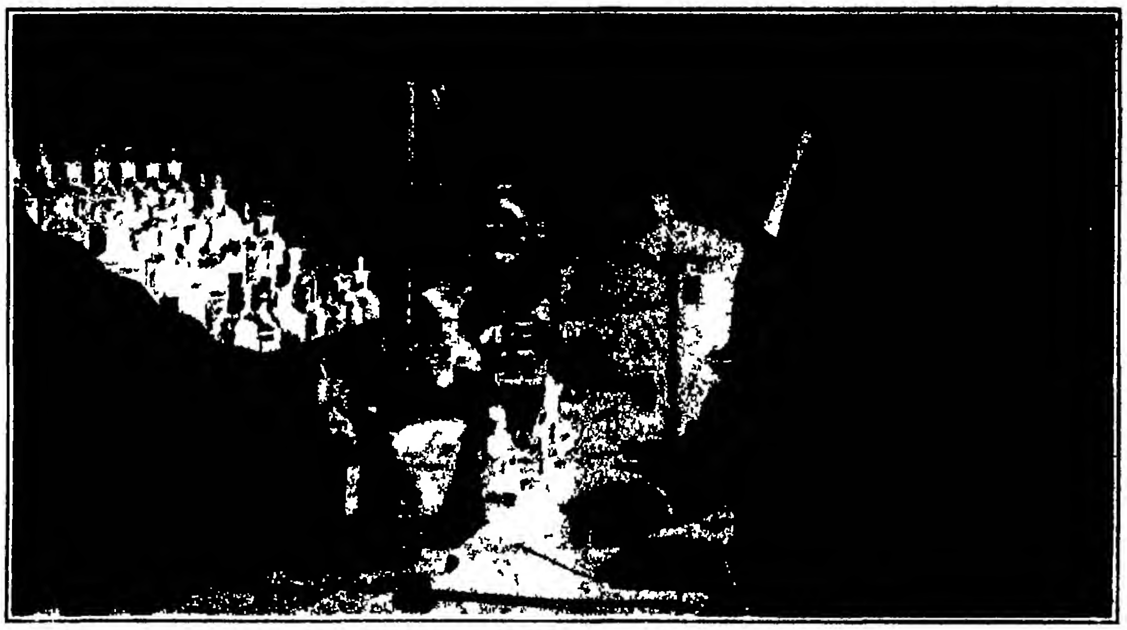
A collection of the leading devices employed by the ingenious trap drummers who supply realistic sounds for our motion pictures

Reading Between the Lines

Methods of Invisible Writing Employed During the War, and Their Detection

By Jacques Boyer

THE art of secret correspondence underwent singular improvement during the war. Correspondingly, too, the chemists connected with the Bureau of Judicial Identity in Paris to whom the study of this subject was confided were obliged to make extensive and assiduous research in order to become acquainted with the astute methods of concealment practiced by German spies. But these French savants went even further by way of foiling the enemy, for they succeeded in devising an absolutely inviolable code for the use of our own spy system.



Making use of chemical reagents in the deciphering of secret writing, the concealed message appears, between the lines of the apparent letter, on application of the appropriate reagent

At the beginning of hostilities our enemies made use of ordinary and well known inks in writing their despatches. Their agents made use of all sorts of *colorless liquids*—materials as commonplace as onion juice or lemon juice or even saliva or urine! It is commonly known that these so-called *sympathetic, mysterious,* or *magic inks* modify the surface of the paper in a manner which is rather physical than chemical, they are easily revealed by very simple methods—either by placing in dilute dyes or coloring matters such as ordinary black ink, or by exposure to the vapors of iodine. The method in which all these developers operate is identical, *i.e.*, they attack those portions of the paper which the writing has altered physically with more energy than they do the unaltered portions.

But later on the technique of the German spy system became more scientific in character and the French commissions, whose function it was to censor the mail, found that true *chemical inks* were making their appearance. The secret text upon the documents seized was written with a solution of some chemical salt, either metallic or organic and protected against iodine and other ordinary developers by the simple method of immersion either in pure water or in water to which had been added a little ammonia or a trace of hyposulfite. Text treated in this manner is affected only by certain definite reagents or a given group of chemical compounds. In order to get at the secret involved in such a piece of writing the expert chemists in charge of the matter must apply in the *proper succession all of the analytic reagents*. But they can obtain the desired result only after lengthy manipulation and at the expense of the neatness of the document. On the whole, however, inks of this sort, composed of liquids having a 10 per cent concentration offer but precarious protection for secrets. It is perhaps a long road to their unveiling but it is none the less a sure one. During this period there was discovered in the baggage of suspected German spies soaps containing potassium ferrocyanide and toilet waters containing lead acetate, and with these as a clue our laboratories were quickly able to decipher suspected documents and a number of spies suffered condign punishment.

As a result of this the Teutonic technologists made a fresh change in their methods. The liquids designed to be used in secret writing were made extremely dilute, the concentration in some cases being not more than 1/50,000 or even 1/500,000. In the first samples of these new inks which came under our observation was detected the presence of organic compounds of silver of the so-called *protargol* type. Chemical analysis is of no avail with respect to this sort of ink, since the metal is protected from ordinary developers, not merely by reason of its extreme dilution, but also by the very nature of the molecule of which it forms a part.

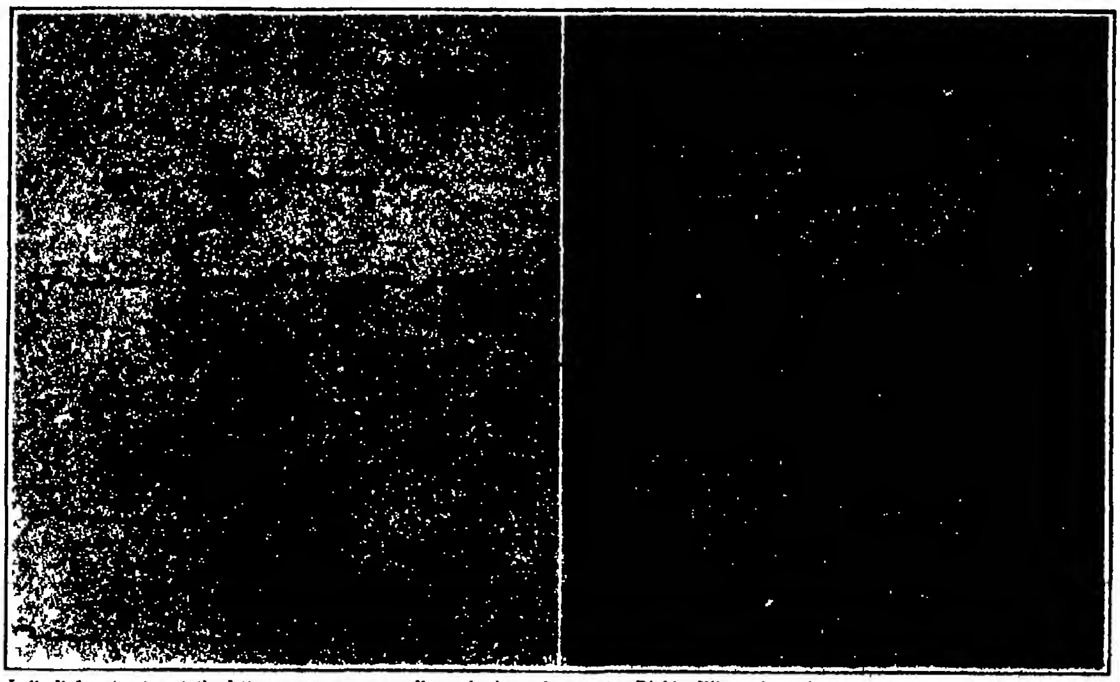
The German spies hid these inks in their shoestrings or socks, which were impregnated with a very small quantity of the substance in question. A sock, for example, containing only a few milligrams of the active substance needs only to be soaked in a glass of water in order to yield a liquid capable of being used as an invisible ink. The developer capable of revealing texts written in this manner was finally discovered by electro-chemical methods.

If infinitesimal invisible traces of certain metals be deposited upon the surface of an insulating material—*e.g.*, a sheet of paper—and if this then be placed in a medium containing a nascent metal, the latter will be deposited by means of electrolysis upon the previously deposited metal traces (which are more or less good conductors), and will render them visible. The easiest type of such a developer to make use of is nascent silver (which is produced when silver nitrate and a reducing agent are placed together). This reagent is effective even in the case of script written with such enormously dilute solutions as those containing only 1/100,000 of the active agent, and so far no substance has been found capable of affording protection against this developer.

But it was not very long after the discovery of this ingenious developer that it became known that in spite of it German agents were conducting secret correspondence across our territory. Just at this time M. Priolet of the Police Department, who was in charge of the Bureau of Counter-Espionage, was notified by his inspectors that the baggage of certain persons of equivocal antecedents contained articles of lingerie, especially handkerchiefs, concerning which they betrayed exaggerated anxiety.

Accordingly one of these handkerchiefs was seized and sent to M. Bayle. After three months of painstaking research this able chemist identified not only the active substance with which the handkerchief had been treated, though the bit of linen contained only a fraction of a milligram of the chemical, but what was far more important, he discovered the *specific developer* required to make it give up its secrets. In this case a catalytic operation is concerned which is so exquisitely sensitive as to furnish a reaction even in the case of solutions so tenuous as to contain only 1/100 000 000 of the active substance! The spy needed only to dip his handkerchief into a glass of water to obtain the invisible ink he needed.

Finally, for the safety of our own secret correspondence M. Bayle invented a special process communicated to the War Department May 6, 1918, for its sole use. In this method four different reagents must be employed *and in a given order*. Texts prepared by this method have been subjected to scrutiny by control committees, who have not succeeded in deciphering them.



Left: Before treatment the letter appears as an ordinary business document. *Right:* When given the correct treatment the real message appears, between the lines of the apparent one

Letter of a spy, seized in course of transmission

Bottling and Labeling Machine for Small Scale Operations

QUITE distinct from the large and elaborate bottling equipment found in big bottling establishments is the small machine shown at the left of the accompanying illustration. This machine has been invented by a Frenchman who had in mind a small equipment especially intended for the small wine merchant. Obviously, the same machine can be used for bottling other liquids, such as oils, medicinal preparations, thin paints, and so on.

In brief, this filling machine depends on the fact that liquids always seek their own level, and on the use of the siphon The wine or other liquid to be bottled is placed in the top container, from which it flows down by gravity into a large basin centrally located. Leading from this basin are a number of radially arranged siphons, the free end of each siphon being placed in the neck of a bottle, as shown The various bottles, it will be noted, are placed on individual stands that can be adjusted to any height. In this manner the bottles can be so arranged that they will fill to any desired height automatically, since the siphon will stop delivering when the level of the central basin is attained. In this manner the operator can place the bottles one by one on the stands, and swing the machine around so as to remove the filled bottles and put empty ones in their place in a continuous operation

The second machine shown in the illustration is a labeling machine. Labels are automatically picked up by an arrangement of rollers, given a layer of mucilage, and firmly and neatly applied on a bottle, can or other form of container The machine is hand driven, and the arrangement of rollers is such that any size or shape of container can be taken care of by simple adjustments.

Aids for the small bottler: Bottle filling machine at left, and labeling machine at right

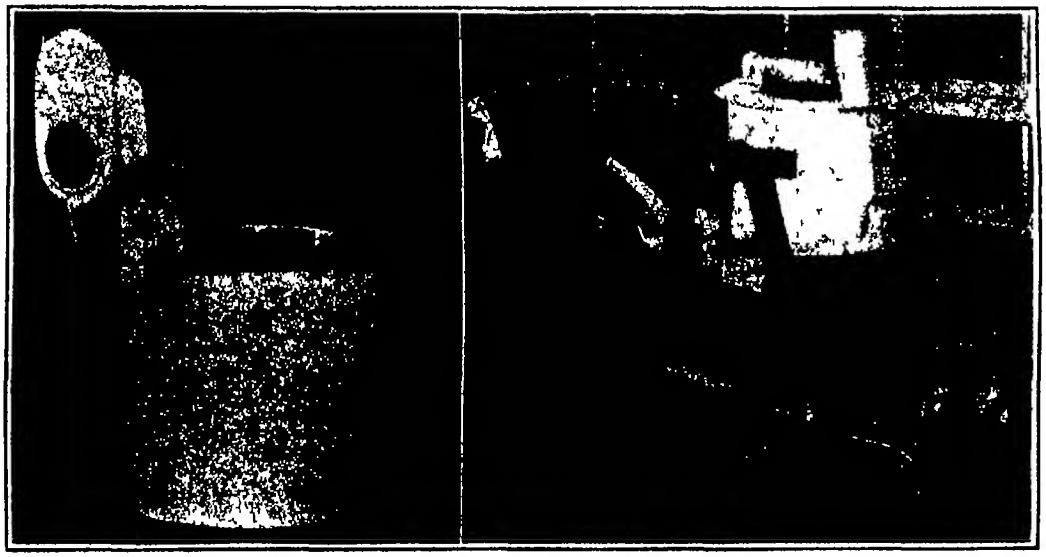
Applying Electricity to the Metal-Melting Pot

ELECTRICALLY-heated metal-melting pots are a decided improvement over gas and gasoline heated pots not only on account of their cleanliness, elimination of open flame and other obvious features, but also because they are more efficient and much more readily controlled In the electrically heated pot, the heat is generated and applied where needed Work rooms are not overheated due to waste heat, the air is not vitiated. Electrically-heated pots, furthermore, effect a big saving in time and labor The metal is kept at exactly the right temperature, and the pot does away with the dangerous and unsatisfactory practice of carrying small quantities of hot metal around in a ladle or bucket The equipment can be installed wherever electric current is available.

Typical of the present electrical melting pots is the type shown in the accompanying illustration This type is designed to melt down and maintain at the proper temperature all soft metals such as leads, tin, solder, babbitt, and so on Pots of this type are limited to a maximum temperature of 550 degrees Fahrenheit

The first pot shown is made in 10 and 25 pound sizes, with a maximum content temperature of 440 degrees. Having current requirements well within the rating of an ordinary lighting circuit, these two sizes can be used in any room where there is an electric light socket. The pot consists of two containers, made of strong sheet metal, placed one within the other. The ample space between the containers is provided with a packing of heat insulation which prevents loss of heat through radiation The heat units are welded to the bottom of the inner container Four feet of cord and a snap switch are provided for manual operation, or automatic control may be substituted.

The bench type of pot is practically the same as the smaller portable pots, except that the heater units are the flat, seamless steel type, and are immersed directly in the metal, with the lead arm coming out over the rim of the pot With this construction all of the heat generated is transmitted directly to the metal, which is melted down with extreme expedition.



Small bench type and 100-pound type of electrically heated metal-melting pots for shop use

The automatic control equipment consists of a dynamic thermometer and a suitable control panel The bulb of the thermometer is immersed in the metal and the operating coil, acting through the control panel automatically opens or closes the heating circuit as the metal temperature rises or falls the very few degrees necessary to actuate the coil contact lever.

Standard Radio Wavemeter

THE Radio Section of the Bureau of Standards tests for government agencies, commercial and university laboratories, and others, a great variety of radio material, especially wavemeters. Not only in connection with radio communication, but also in a wide and growing field of electrical research there is an insistent demand for accurate measurement of the wave length or frequency of rapidly alternating currents. In the standard wavemeter most recently designed by the Bureau, careful attention has been given to the electrical and mechanical considerations which make for accuracy, especially rigidity of construction and precision of set and reading This wavemeter, when calibrated, will be capable of measuring wave lengths from 65 to 85 000 meters, or in terms of frequency from 3500 to 4,600,000 cycles per second.

A typewritten description of this wavemeter has been prepared and is available for distribution to interested persons, who may apply to the Bureau

Weights Constructed of Magnetic Material

A FEW months ago in investigating three imported sets of analytical weights it was found that the weights from 5 to 05 of a gram were made of a decidedly magnetic material. During the past month a similar set, several years old, was likewise found to have magnetic weights which caused great irregularities when an attempt to calibrate them was made Weights of this character can be readily detected by using a small magnet and it is well for purchasers of analytical weights to be on their guard against them as under some circumstances serious errors may be introduced by using such weights.

Seeing Old Paintings as They Were Originally Painted

THERE has long existed the belief that the darkening of pigments which occurs in the course of hundreds of years enhances the beauty, and therefore the value of old and rare oil paintings. However, it has remained for a French scientist, M Pierre Lambert, to reveal any old oil painting in its original colors so that a comparison of the original color values and these bestowed upon the canvas by the lapse of years may be made

First of all, M Lambert illuminates the old oil painting by means of a powerful arc or gas-filled incandescent lamp and a novel optical system The rays from the illuminant are passed through a condenser followed by a lens and a polarizing device known as the Nicol prism, and again a lens which spreads or diverges the rays, so as to illuminate the entire area of the painting The observer, looking through the Nicol prism, manipulates the prism until he finds a position in which superficial reflections are entirely suppressed. It is said that old dull pictures then become quite distinct the colors are intensified, and details that have long been lost to the naked eye are revealed in their original form Aside from its pure art value the instrument should be of great use in detecting forgeries on which the marks of age have been artificially laid.

Apparatus devised by a French scientist for the purpose of examining old paintings under polarized light and with the aid of the Nicol prism, in order to suppress superficial reflections

Design Patents

What They Are, and the Rules Governing Recovery for Infringement of Them

By T. Hart Anderson of the New York Bar

PATENTS for designs secure to the owners thereof the right to exclude all others from manufacturing, using and selling articles of manufacture embodying an infringing design. Thus the owner of a design patent is entitled to an injunction to restrain not only the unauthorized manufacture of articles embodying an infringing design, but also the unauthorized use and the unauthorized sale of such articles of manufacture. In addition to this injunctive relief the owner of a design patent which has been infringed is entitled to recover from one who has manufactured and sold articles of manufacture embodying an infringing design, all the profits which have accrued from such manufacture and sale, and if there be no such profits, or the amount thereof is less than would have been made by the owner of the patent had he sold the same number of articles, then he may recover a sum equaling what he would have made under the assumption that he would have manufactured and sold such articles if the infringer had not done so. Of course the right to recover presupposes the validity of the design patent and that the owner thereof has given notice of his patent by affixing to the articles of manufacture embodying the design the word "Patented," together with the date of the patent, or has given actual notice to the infringer, in which latter case at the trial he must not only prove such notice but must further prove that *after the receipt of such notice the infringer continued his infringing acts*. Damages can only be recovered when the statutory notice has been given (R. S. Sec. 4900.)

The law relating to design patents contains a provision specifying a minimum sum which may be recovered for the infringement thereof. This is contained in the Act of February 4, 1887, which reads as follows:

"Act of February 4, 1887.

"Be it enacted, etc. That hereafter, during the term of letters patents for a design, it shall be unlawful for any person other than the owner of said letters patent without the license of such owner, to apply the design secured by such letters patent, or any colorable imitation thereof to any article of manufacture for the purpose of sale or to sell or expose for sale any article of manufacture to which such design or colorable imitation shall, without the license of the owner have been applied, knowing that the same has been so applied. Any person violating the provisions, or either of them, of this section shall be liable in the amount of two hundred and fifty dollars; and in case the total profit made by him from the manufacture or sale as aforesaid, of the article or articles to which the design, or colorable imitation thereof has been applied exceeds the sum of two hundred and fifty dollars, he shall be further liable for the excess of such profit over and above the sum of two hundred and fifty dollars, and the full amount of such liability may be recovered by the owner of the letters patent, to his own use, in any circuit court of the United States having jurisdiction of the parties, either by action at law or upon a bill in equity for an injunction to restrain such infringement."

It will be noted that it is unlawful for anyone, other than the owner, without the license of the owner, to apply the design to an article of manufacture for the purpose of sale or to sell or expose for sale such an article knowing that the design has been so applied. It is further provided in this section that anyone violating these provisions shall be liable in the sum of $250, or if the total profit arising from such infringing acts exceeds the sum of $250, he shall be liable for the excess over and above that sum.

How shall a dealer know that a patented design has been applied to an article of manufacture "*without the license of such owner*"? Obviously, in the case of an infringing manufacturer mere knowledge of the existence of the patent of another is sufficient, for if he knows of the existence of the patent and he does not have the license of the owner of that patent, he knows that he is manufacturing for the purpose of sale an infringing article, to which the design has been applied without the consent of the owner of the patent so that so far as the manufacturer is concerned it is only necessary to prove that the owner of the patent has given to the infringing manufacturer statutory notice as hereinbefore set forth. It is not necessary to prove that he has no license; if he has a license it is for him to prove the fact.

But how about a retailer? He may know of the existence of the patent from the statutory notice applied by the owner to the articles which the owner makes and sells, but how can a dealer possibly know unless specifically advised that articles of manufacture offered to him by other manufacturers embodying the same design have had the patented design applied thereto without the license of the owner of the patent? Retailers are offered the same article by different manufacturers. They are not supposed to inquire when they are solicited to purchase articles for resale whether such articles are patented or not, or whether any particular design has been applied thereto with the license of the owner of a design patent. A retailer, therefore, who sells or offers for sale articles of manufacture to which has been applied an infringing design is not liable for the penalty of $250 unless it is proved that he knew of the patent, and also that before he offered the same for sale or sold the same he knew that the design had been applied to such articles without the license of the owner of the patent. This does not mean, however, that he is not liable at all, for if he has sold an infringing article he may be sued under proper conditions precedent, such as notice of the patent for the purpose of recovering the profit which he has made by the sale of the infringing articles which may or may not exceed the sum of $250, but the owner of the patent has no right to demand the penalty in the absence of proof of knowledge on the part of the retailer before he sold the article, not only that the design is patented, but that it has been applied to such article *without the license of the owner of the patent*. Should a retailer get notice that an article offered for sale and sold by him constitutes an infringement of a design patent it will be sufficient for him in order to avoid the payment of the penalty of $250 to at once take the infringing article off sale and to notify the owner of the patent of that fact. If after the receipt of such notice he makes a sale of an infringing article, even of a single specimen, or offers the same for sale he will be liable for the penalty.

This question came up and was decided by the Circuit Court of Appeals for the Third Circuit, in a very able opinion written by Judge Acheson in the case of Gimbel vs. Hogg, 97 Fed. Rep., page 791, wherein the court states:

"By the plain terms of the statute, the penalty is incurred by the seller of an article to which a patented design has been applied without license, only where he sells 'knowing that the same has been so applied.' The statutory punishment is for infringing knowingly. Clearly it was not intended to subject to a penalty a vendor acting in good faith and selling in entire ignorance of any infringement perpetrated by the manufacturer. For the infliction of the penalty the statute contemplates and requires knowledge by the seller of the unauthorized use of the design by the manufacturer. Such knowledge is not to be imputed to the seller from the 'notice to the public' by the marking required of the patentee by Section 4900 of the Revised Statutes."

In the same decision it was held that such notice was sufficient against the manufacturer who applied the design because he must know, if he knew of the patent, that he did not have a license thereunder. The court further stated in that decision:

"But the public notice by marking, under Section 4900, gives no information whatever to a seller of an infringement committed by the manufacturer, and that section has no such purpose."

There has been a campaign in recent years, particularly in the lighting fixture trade, whereby certain owners of design patents have proceeded against manufacturers of infringing articles, and when they have been so fortunate as to have had their patents sustained against the manufacturers they thereafter proceed against retailers who have sold articles purchased from such manufacturers, and such retailers have been led to believe that the owner of the patent is also entitled to collect the penalty of $250 from the retailer who offers for sale and sells such infringing articles, and in many instances—sometimes where the retailers have sold only two or three specimens of the infringing articles—they have been induced to pay this $250 rather than stand the expense of a suit. In all such cases the owner of the patent was not entitled to recover the penalty unless he could show that the retailer not only knew of the patent, but also knew when he offered the infringing articles for sale and sold the same that the design had been applied thereto without the license of the owner of the patent. It is believed that in many of these cases the retailers have been absolutely without this knowledge. They may have known of the patent, but it is doubtful whether they knew or took the trouble to find out—and they are not obliged to take the trouble to find out—that the design had been applied to such articles without the license of the owner of the patent.

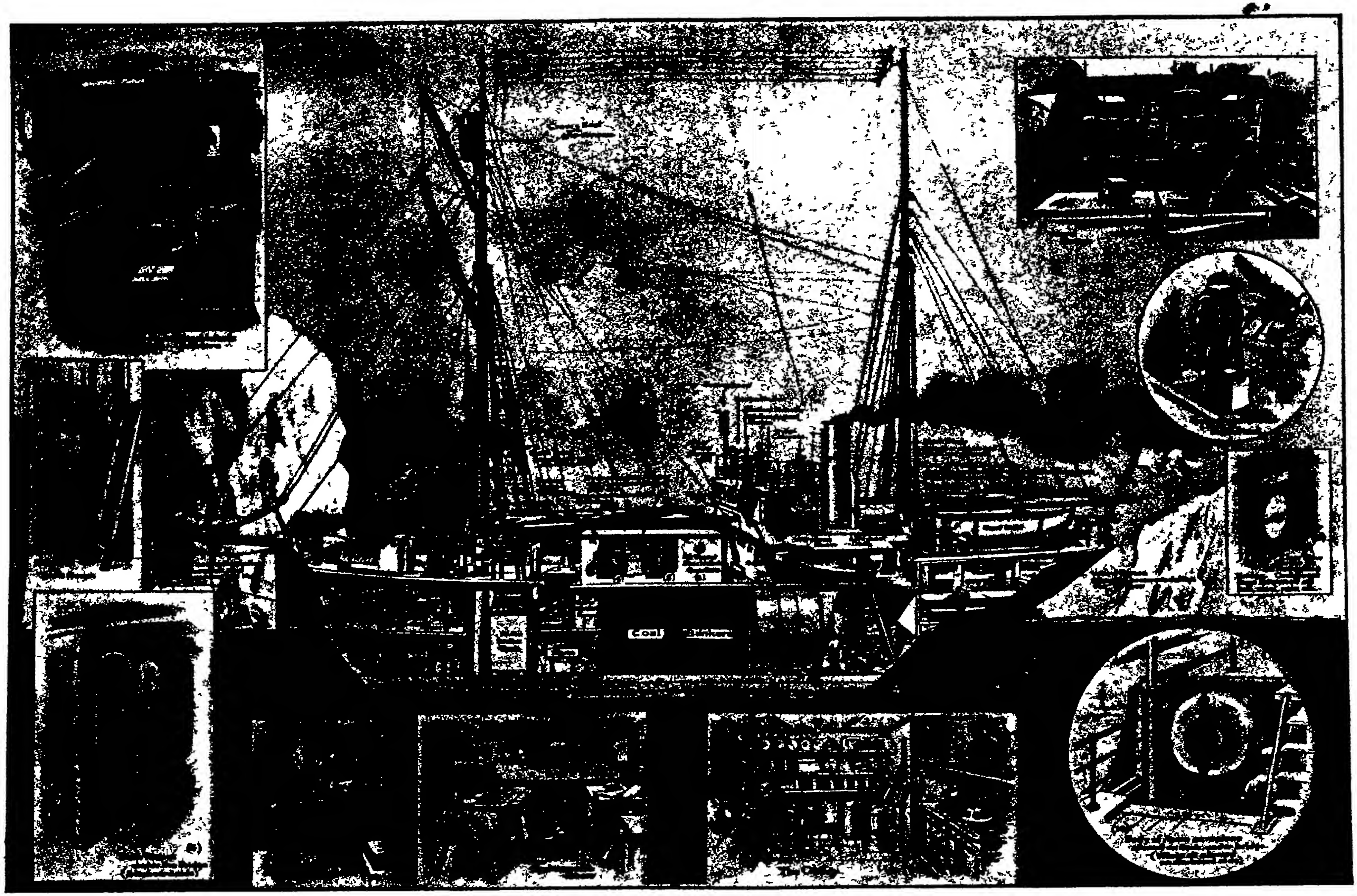
In no event can the owner of a design patent recover the penalty of $250 from a dealer unless in addition to the notice of the patent the dealer is notified that the design has been applied thereto without the license of the owner of the patent, and after the receipt of such a notice offers for sale or sells such infringing articles. In order to render a dealer liable for the penalty the notice must be specific—not only that the design is patented, but that those articles offered for sale by him have had the design applied thereto without the license of the owner of the patent. If after the receipt of such a notice the dealer at once ceases the sale of such infringing articles he can not be held liable for the penalty. Design patents should be respected quite as much as structural patents, and when one has knowingly infringed he should be made to answer to the owner, but the penalty is only incurred under the circumstances here noted.

THERE appears to be a good deal of doubt and misunderstanding in the mind of inventors as to just what ground is covered by a design patent. At the same time it is not altogether clear to the retail merchant just what protection he has against penalties for unintentional and unknowing infringement of a design patent. It is to clarify this matter that we have asked Mr. Anderson to prepare the article that appears on this page. We believe he makes it entirely clear that a design patent is on substantially the same footing as a patent of the more usual variety, while at the same time the innocent third party to an infringement is amply protected.—THE EDITOR

Facts of Importance in Regard to Relief of Eye Fatigue in Industry

INSUFFICIENT illumination represents an abuse of the eyes, and a careful regulation of the illumination in our factories, offices, homes, etc. should be observed in order to support our eyes in their functioning, says *Electrical Review*. How can this best be accomplished? The answer must be "Study Daylight Effect."

The following specific points are cited: (1) Dark corners should be illuminated with diffused indirect light of sufficient intensity to prevent excess of contrast of all illuminated objects in areas surrounding them. (2) The eyes should not be exposed to direct light sources of any kind. (3) The excess of the yellow light from most of our artificial light sources should be neutralized by blue filters of suitable tint in order to approach daylight color. It is not necessary to obtain absolute standard daylight quality as determined spectroscopically, since our light sense overcomes a considerable variation of color combinations in the light source without experiencing fatigue. (4) When work is to be done on bright light-reflecting surfaces the illumination should be as much as possible of a grazing incident so that the light rays may not reflect direct into the eyes of the worker. (5) Cheerful surroundings, well illuminated, add a great deal to the comfort of the individual—remember that seeing is a nerve action. (6) Attractive soft color schemes of variety in workrooms will prove to be refreshing to the eye, monotony in color should be avoided. (7) Neither red walls nor pure white walls are inviting, the former tend to fatigue, the latter glare and tire the eye. Neutral gray as a base color is restful to our eyes, while bright multiple color effects are exciting. (8) Fine detail work does not demand brilliant illumination, a soft velvety light of moderate intensity will prove far more satisfactory in order to prevent eye fatigue. For extremely fine detail work optical appliances should be made use of in order to magnify the images of such objects on the retina, illumination alone will not suffice.



THE little "Quest" is the ship of the Shackleton-Rowett Oceanographical and Antarctic Expedition, led by Sir Ernest Shackleton, and financed by Mr John Quiller Rowett. She recently sailed from London Bridge on a voyage of 30 000 miles, expected to occupy two or three years. One of the objects is to find various doubtful or unidentified islands which might be useful as whaling, coaling, or wireless stations. Others are to make a hydrographical survey to obtain ocean soundings and meteorological information for the Air Ministry, which provided instruments, balloons, and kites. The equipment of this little ship is unusually complete and should afford the maximum comfort to the men engaged in a most interesting work A Baby Avro seaplane is carried, as shown in the drawing for which we are indebted to the *Illustrated London News* The "Quest" was built in Norway in 1917 for sealing in the White Sea. Her hull is of stout oak and pine specially designed for withstanding ice pressure, and the bows are strengthened with steel. She is only 111 feet long, and of about 200 tons. She carries 120 tons of coal, and has a steaming radius of 9000 miles. The central drawing shows the details of the ship, and the numbered portions (1 to 10) are illustrated on a larger scale in the margin with numbers corresponding No 3 (the bathroom) does not appear on the central drawing as it is on the starboard side. In Sir Ernest Shackleton's quarters may be noted a box marked "Open on Christmas Day" In front of the bridge is a brass plate inscribed with three verses of Kipling's poem, "If." The Sperry gyro-compass (No 4) depends for its action on the earth s rotation and the force of gravity It is non magnetic, and always shows the true geographical north and south. Of the two sounding machines, the Lucas (near the fore mast) is for stationary deep-sea and hydrographic work, and the Kelvite for "flying" or navigational soundings with the ship in motion. The radio equipment has a range of 1500 miles by day and 9000 miles at night. The wings of the airplane are stowed on the starboard side of the same deck as the body

THE "QUEST," A NORWEGIAN SEALING SHIP WHICH HAS BEEN REFITTED FOR SIR ERNEST SHACKLETON'S NEW ANTARCTIC EXPEDITION

Recent Discovery in Greek Lands

A Sketch of the Principal Excavations and Discoveries of the Last Fifty Years

PROFESSOR F H MARSHALL, of Birkbeck College, London, has recently given us a work of little more than one hundred pages, which will undoubtedly appeal to the general reader Nearly everyone wants to know something of the progress of discovery in Greece and Greek lands, and through the courtesy of the Cambridge University Press we have been enabled to use some of the pictures from Professor Marshall's book

The explorations since 1870, in chronological order, naturally fall into well-defined geographical groups. The first group, Northern Greece, begins in 1871 and includes the quarter of Athens near the Dipylon gate These excavations were carried on for twenty years The remains belong to the later prehistoric period, or about 1000-700 B C In 1873-4 the world was startled because of the striking beauty of the finds at Tanagra, where an unrivalled series of terra-cotta statuettes was found, for the most part women in their picturesque costumes. Systematic excavations of the tombs showed that the graves were of several forms Sometimes rock hewn, sometimes built up of stone slabs the dead were frequently buried in sarcophagi, in which the figurines were found with other objects. Some of the statuettes were archaic, but the bulk are of the fourth century B C In 1875 we have excavations at Dodona, and in 1892 the Delphi sanctuary in the northern part of Greece both devoted to oracles. From 1880 to 1886, Dr Henry Schliemann carried on excavations at Orchomenos, and discovered in the latter year a remarkable beehive tomb Between 1882 and 1887 the Greek Archæological Society completely cleared the temple site at Eleusis, the great center of the mysteries of Demeter and Persephone These excavations have given us some extremely valuable remains A sanctuary oracle of minor importance was that of Amphiaraos which lies among hills near Oropos, it was excavated between 1884 and 1887 Part of the temple plan, a long colonnade in which patients probably slept when awaiting the dream-revelations, and a small theater were uncovered

Some of the most important excavations ever made on the mainland of Greece were those of 1884 upon the Acropolis of Athens. The excavations were begun at the Propylaea and continued round the Acropolis, resulting in the discovery of a very early "Pelasgic" wall To the south of the Erechtheum the remains of an early sixth-century temple, the "Hekatompedon," or temple one hundred feet in length, came to light Very important sculptures in soft stone belonging to this early temple were found, these were originally colored, a device which would go far to conceal defects in the stone. Another sanctuary site was excavated on a three-peaked mountain of Bœotia at Ptoïon in 1885-6. Inscriptions throw light on the worship of Apollo Ptoïos. The temple had the right of asylum, and there was also an oracle attached to it.

In Bœotia, four miles to the west of Thebes, the temple of the Kabeiri was excavated by the Germans in 1887-8 The temple, though several times reconstructed, was in existence from early Greek to Roman times. It is of peculiar structure, having four internal divisions instead of the normal three. The Kabeiri seem to have been deities of a subterranean character, half goblins, whose worship flourished in the island of Samothrace as well as in Bœotia. At Thebes they are found in the relationship of father and son, as may be judged from the objects excavated from the temple. The potsherds frequently show grotesque scenes and parodies, while several votive objects, such as bells, wheels, figures of bulls, and terra-cotta models of tops, are inscribed with dedications to the two deities.

The most famous oracle of Greece was at Delphi, situated amid rugged mountain scenery in Phokis. Various preliminary excavations were carried out in 1840, 1860-1, 1880-7, but the main excavations were conducted by the French School under M. Homolle from 1892 to 1903. We first enter the sacred precinct at the southeastern corner of the sacred way Here on either side were the various offerings made by the different states, such as the bronze bull dedicated by the Corcyræans, and the 38 bronze statues erected by the Spartans in commemoration of their victory at Ægospotami Next came the various "treasuries," small shrines dedicated by the various cities of the Greek world Most of these treasuries are situated near the bend of the sacred way toward the north

Strabo attributes the greatness of Delphi to these treasuries "which peoples and kings founded, and into which they placed their dedicated wealth, and the works of the greatest artists." True to this description, the treasure houses have furnished some interesting sculptures. That of the Sikyonians, built about 580 B C., has a score of metopes, the subjects of which are identified by inscriptions—Europa carried off by the bull, Helle on the ram, the hunt of the Kalydonian boar, etc The most striking series is, however, that furnished by the treasury of the Knidians, built about 510 B C., the façade of which, as restored in the Museum of Delphi, is shown on p 37 The frieze represents on the left an assembly of the gods, on the right a combat between the Homeric heroes and Æneas on the Trojan side and Menelaos and Meryon on the Greek side. They are fighting over the body of Euphorbos. In the pediment or triangular gable is a group representing the legendary struggle of Apollo and Herakles for the Delphian tripod. The foreground in the illustration is occupied by the colossal figure of a seated sphinx, probably an offering of the Naxians made in the first half of the sixth century, B. C. It originally stood on a column south of

Map showing the principal sites of discoveries in Greek lands, after Marshall


Theater at Pergamon, seen from the north

the retaining wall of the temple of Apollo. The remains of this famous temple of Apollo, in which the Pythia gave the inspired oracles of the god, are scanty, for it was much rifled for building material in the Middle Ages.

Excavations were made in 1897-1905 at Thermos, in 1890 at Megara, in 1901 at Ægina and 1907-8 at Rhitsona

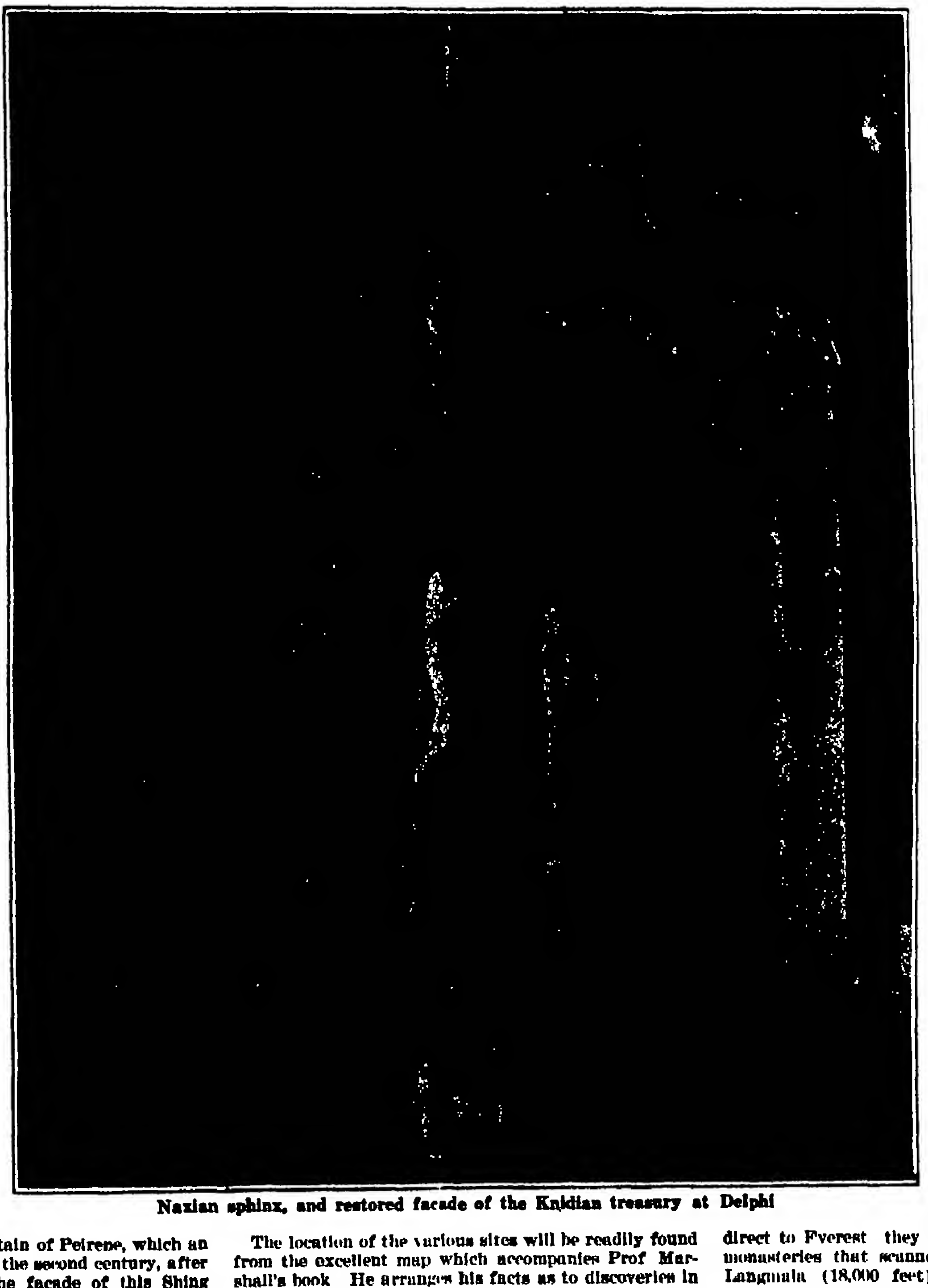
Having now finished with Northern Greece, we come to the long list of explorations in the Peloponnesos. The work of the greatest interest is undoubtedly that at Mycenæ (1874-6) and Olympia (1875-8) The center of Mycenæan civilization seems clearly to have been Mycenæ, famed in the Homeric poems as the home of Agamemnon, who led the great expedition against Troy, and famed, too, for its wealth in gold. Mycenæ is situated on hills which rise from the Argive Plain, some nine miles from the sea. It consists of two distinct parts —a high town, or acropolis, and a lower town. The acropolis, which is the older part of the city, was first excavated by Dr Schliemann in 1876. Beneath the acropolis to the west and southwest lies the lower city of Mycenæ. Here an area of some 1000 by 275 yards was enclosed within walls. The most important remains of this city are the "beehive" tombs, two of which have been found within the walls of the lower town, five outside.

Olympia was the great center of Greek athletic life in Elis in the Peloponnese, a site famous for many reasons, but perhaps not least as supplying the theme of many of Pindar's most majestic odes. The sacred precinct, or Altis, which lies in a broad plain between the rivers Cladeus and Alpheus, was excavated by the German Government between 1875 and 1881, although the Temple of Zeus had previously been explored by a French expedition in 1829.

Other excavations were carried on from 1880 to 1900 in chronological order, as follows Tegea, Epidauros, Tiryns, Mantinea, Lykosura, Vaphio, Megalopolis, Argos, Corinth and Sparta. The author describes each site and what was found there in detail The most interesting discoveries, perhaps, in this list were those at Argos, 1892, carried out by the American School and the older excavations of Tiryns, so famous in Homeric poems.

We find that very important light has been thrown on ancient Corinth by the American excavations begun in 1896 by their school at Athens, and continued in succeeding years. Perhaps the most interesting discovery is that of the famous fountain of Peirene, which an ancient traveler, Pausanias, in the second century, after Christ, described. In 1898 the façade of this Shing was discovered, and the different stages of its building can be traced from the first simple grottoes, with cross walls to support the roof, to the elaborately veneered façade of Roman times, which has in front of the grottoes arches decorated with Doric and Ionic half-columns.

Leaving the mainland our author deals with the discoveries of extraordinary interest made in the islands, particularly Delos, Melos, Crete, and Cyprus. He deals also with the discoveries in Asia Minor at Ephesus, Troy, Pergamon, Priene, Miletus and Sardes, as well as places in Syria and Egypt, such as Sidon, Naukratis and Daphnæ. The excavations of Troy by Drs. Schliemann and Dörpfeld are too well known to do more than refer to The excavations at Pergamon are less well known. This city has been compared in its general situation with Edinburgh The acropolis, which rises nearly a thousand feet, corresponds to Edinburgh Castle, the Hellenistic town at its foot to the Mediaeval part of the Scottish capital, and the Roman city on the outskirts to Edinburgh New Town The excavation of the acropolis was begun by the Germans in 1878, and the first and most striking discovery was that of the sculptured slabs of the Great Altar of Zeus Another structure belonging to this city, the theater, presents a remarkable appearance when viewed from above, and is a good instance of the way in which the Greeks took advantage of a natural slope for theater construction



Naxian sphinx, and restored façade of the Knidian treasury at Delphi

The location of the various sites will be readily found from the excellent map which accompanies Prof Marshall's book He arranges his facts as to discoveries in chapters dealing with the great periods—the earlier prehistoric, the later prehistoric, the earlier historic and the later historic period There are also chapters on temple sites, and some isolated discoveries. There is also a select bibliography which covers the ground admirably and a chronological list of excavations which we have used as a guide for our all too brief notice, using it to hark back to Prof. Marshall's text The book gives in condensed form what the average reader wants to know with all the unnecessary details eliminated. Other books on archæology so admirably abridged in the treatment of interminable non-essentials would be very welcome.

The Strength of Papers

In a new publication of the Bureau of Standards, Technological Paper No 194, entitled, "A Preliminary Study of Tearing Instruments—Tearing Test Methods for Paper Testing " a study is made of the relative effect of different sizes of test samples on the tearing strength of paper Data are presented to show that the larger the test samples the greater are the values of tearing strength There is also taken up a study of two types of tearing instruments on the market The degree of accuracy of each instrument is determined, and the errors are plotted in the form of curves. In the conclusions, the good and bad qualities of these instruments are discussed at length

This publication is now ready for distribution and anyone interested may obtain a copy by addressing a request to the Bureau of Standards until the free stock is exhausted.

The Mount Everest Reconnaissance

OFFICIAL accounts have come through of the July August activities of the scientists investing Nature's mightiest fortress in the hope of taking it by escalade A month was spent in trying the northern and western approaches only to end in the conviction that both faces present insuperable difficulties to any material advance The south side also presented only unclimbable precipices, and the remaining hopes centered on the east and northeast faces. Breaking camp at Tingri, the adventurers had in crossing a spur from Chhoebuk to Rebu, a magnificent view of the northern face of Everest almost encircled by great bands of perpendicular black rock that seem absolutely unscalable Pressing forward some fine scenery was opened up with a background of glaciated peaks 23,000 to 24,000 feet high Two miles down the Arun valley one of Everest's big glacier streams was encountered Here, on an old river terrace, the new base camp was pitched at more than 12,000 feet Col Howard Bury gives piquant thumb-nail sketches of a neighboring high level valley with 14 lakes varying from black-green to turquoise blue, the ground was carpeted with many varieties of gentians, with embossed designs in rhododendrons and deep-claret meconopses.

On August 2nd Messrs. Bullock and Mallory started to explore the eastern approaches, up to this time photographic surveys and maps had been made covering more than 9000 square miles of new country The explorers were striking for a valley that apparently led direct to Everest they passed prosperous villages and monasteries that scanned a majestic panorama from Langmala (18,000 feet) Four thousand feet below them lay three giant glaciers, one of which came from Everest Descending, they pushed forward in the face of great difficulties, ascending again, they found themselves on a spur immediately opposite Mt Everest the air filled with the thunder of falling ice as huge masses broke away from the suspended glaciers and plunged into the Kangshung glacier below The climbers were attempting to discover into which of two valleys the glaciers came down As to the main issue the disappointing conclusion was reached that the eastern face of Everest afforded no possible means of reaching the summit The return journey, by another route, led across the Field of Marigolds, opposite Makalu peaks.

A Garbage Crisis

Must We Solve Anew the Problem of the Disposition of Domestic Wastes?

By Harry A. Mount

OH, for a Moses of the Garbage Can! For forty years engineers in this country have been leading certain industries and our municipalities toward a Promised Land, where garbage and similar materials would cease to be merely wastes that must be disposed of at large expense, but would be made to yield valuable products which would pay for their disposal, or might even show a balance on the profit side of the ledger.

Now it appears that what we thought was the Promised Land just ahead was perhaps only a mirage for an economic condition has arisen which apparently makes the plan impossible of success and all of the progress of nearly a half a century along this line may be wiped out. Where is the man, or where is the idea, that can save the $7,500,000 invested in garbage reduction plants still operating, which embody the best thought American engineers could offer to those confronted with a problem of garbage disposal?

In brief, the present-day system of garbage reduction (the only system which seeks to turn to economical use the constituents of garbage) is founded on the thought that some of the contents of garbage are valuable. Destroy this value and the whole system fails. That is what has happened.

Garbage ought to be regarded as a liability and not an asset. The problem primarily is to be rid of the garbage as cheaply as possible in an inoffensive manner. Normally the reduction process meets these requirements perfectly, and, as well, salvages the useful material present.

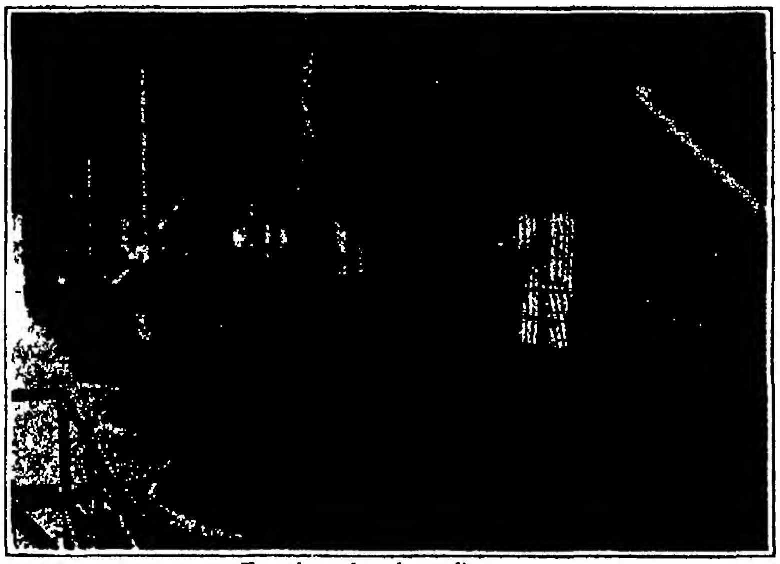
The principal material salvageable from garbage is grease. For the ten years prior to the war this grease found a ready market among soap and candle makers. The value of garbage grease reached a peak during the War and it seemed as if the success of the scheme was certain. But since the signing of the armistice this country has been flooded with millions of pounds of oils from the Orient, and tallow from South America, produced in these countries so cheaply that competition with them is impossible. These products have the additional advantage that they are cleaner than garbage grease and therefore do not have to be so thoroughly processed by the soap or candle maker. The South American tallow supplies candle makers with a first-rate product at a minimum of cost and the soap maker has his choice of such Oriental products as soy bean oil, non-edible fish oils, and wool grease. These come chiefly from China, Japan, Korea, Manchuria, and India.

In the ten years from 1905 to 1914, inclusive, garbage reduction plants had no difficulty in disposing of their garbage grease at an average price of 4¼c a pound. During the war, two or three times that much could be had and the demand greatly exceeded the supply. Now the best price obtainable is from 1¼c to 2c a pound (dependent on quality and distance it must be hauled), and there is little or no market at any price. This fact, coupled with other unfavorable circumstances, has made it impossible to operate a garbage reduction plant except at a large loss. This means that all of the privately owned plants which have not already shut down will soon have to do so, and sooner or later the municipal plants must follow their example.

The tragedy is not so much in the money loss involved as in the fact that the state of the art will be set back a good forty years. There is no other method of garbage disposal which has been widely accepted as satisfactory.

It is true that there are methods of garbage disposal now in use which are much more widely used than reduction, but these are admittedly makeshift methods or of doubtful economic value.

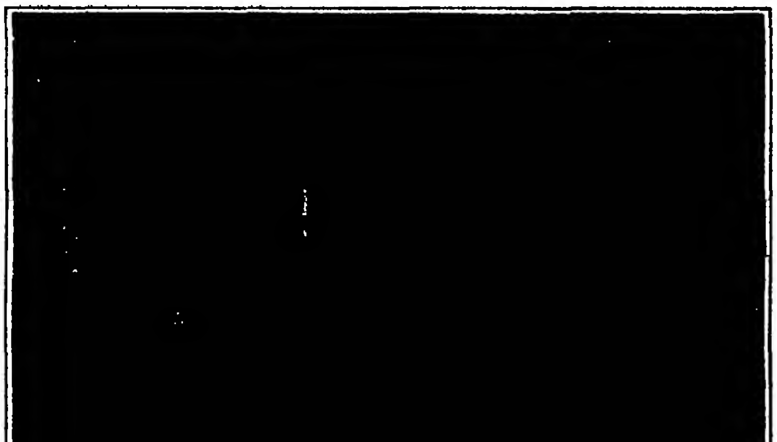
It is true, also, that there is a great diversity of opinion as to whether reduction is the best method of garbage disposal. But the idea has been steadily gaining ground in the past few years and with improvement in machinery and methods it has shown steadily better results. The system as it is usually carried out consists in "digesting" the garbage by steam cooking under pressure in large tanks. This breaks down the materials so that the grease can be extracted. The solids which remain are partially dehydrated and sold as 'tankage' for use as fertilizer.



Top view of garbage digesters

The optimism with which the process was generally regarded may be surmised from the following paragraph from a bulletin issued in 1919 by the Department of Agriculture.

"Several important sources of recoverable fats and oils are still overlooked in this country. One of the promising of these is city garbage. Some idea of the total amount of grease that might be recovered from our domestic wastes may be gained from the actual yield of 4,000,000 pounds from the reduction plant operated by the city of Chicago. Armour & Company contracted to buy this quantity of grease from the city at a price of 11.57 cents a pound in 1918 and the Emery Candle Co. pays 13.5 cents a pound for a similar grease obtained from Washington garbage. It has been stated by an authority on the subject of garbage disposal that 80,000,000 pounds, over $3,000,000 worth of grease, which could be converted into 4,400,000 pounds of nitroglycerine and almost 40,000 twelve-ounce cakes of soap, goes to waste in 24 hours in our large cities alone. If this garbage from a combined population of 5,000,000 were properly utilized, we would get, in addition to the grease, 60,000 tons of fertilizer, sufficient to grow a 3,000,000 bushel wheat crop."



The digesters as they appear from below

W. J. Springborn, a noted authority on garbage disposal, estimates that under normally favorable conditions, the reduction system might be expanded to economically care for the garbage from all American cities of more than 100,000 population. From these there could be recovered yearly about 135,000,000 pounds of grease and 265,300 tons of fertilizer, the combined value of which would be nearly $11,000,000. The railroads would receive nearly $2,000,000 for hauling the grease and fertilizer and another $725,000 for freight on coal and other supplies needed by the plants.

As a matter of fact, during the war even better results than these were obtained from our army cantonments. The situation was most favorable, here, however, because the separation, collection, etc., of the garbage could be most closely controlled. In spite of the fact that wherever a good dumping place could be found (as a large body of water) no attempt was made at reduction, the sale of the camp wastes developed a revenue of more than $1,000,000 a year.

At this writing twenty four large garbage reduction plants are still in operation in this country, many others having shut down. Of these plants, fourteen are owned by municipalities, as follows: Chicago, Philadelphia, Cleveland, Indianapolis, Washington, Rochester, Columbus, Syracuse, Dayton, Bridgeport, New Bedford, Wilmington, Del., Reading and Schenectady. The remaining ten are operated as private enterprises and dispose of the garbage of one or more cities each on a contract basis.

In addition to these, numerous plants have closed down all over the country. A great plant on Staten Island, constructed by private enterprise at a cost of more than $3,000,000, to dispose of the garbage from New York City, has recently been sold as junk for $225,000. The immediate prospect is most uninviting. What is to be done? Cities must continue to dispose of their garbage in as nearly as possible an inoffensive manner regardless of the merits of the several systems of disposal or the economic situation.

It would seem at first thought that great hog farms might solve the garbage problem for large cities. It is pretty generally a practise among smaller American cities to feed the garbage to hogs. Rudolph Hering, a New York engineer, who has been the most prolific writer on the subject of garbage disposal, has this to say of hog feeding in a book just off the press:

"The method of disposal by feeding to hogs has spread to many cities. With pork at present prices, garbage will produce from $7 to $8 in value per ton. Thus for communities where the garbage can be properly collected and controlled, no other method shows equally high returns."

It ought to be noted that the last qualifying sentence almost always limits the usefulness of hog feeding to small cities because it is impossible to control and collect properly the garbage in large cities, or at least because only part of such garbage is useful for hog feeding. Furthermore, it has been pretty definitely proven that garbage is not the best food for hogs under any circumstances and that garbage-fed hogs are particularly susceptible, because of lowered vitality, to cholera and other diseases. This introduces into the business of hog feeding a gambling element that increases as the size of the herd and the size of the city furnishing the garbage increases. In spite of these facts several large cities now feed their garbage to hogs, notably Albany, Denver, New Haven, Providence, Springfield, Mass., and Worcester. Many other cities feed to hogs only the choice parts of the garbage, such as is secured from hotels and restaurants, and dispose of the remainder in some other way.

About the only other methods of garbage disposal are

to dump the waste into some large body of water, throw it on a dump, bury it, and burn it. New York City now utilizes the first of these methods and hauls its garbage to sea and dumps it. But inland cities usually have to choose some other method, and even New York finds the method of dumping at sea not entirely satisfactory, since the barges must go on a long and expensive ocean voyage or the city's chickens will come home to roost in the form of garbage-strewn beaches. As a matter of fact, on some of the ocean front near the big city the volume of tidally deposited garbage is right now a serious problem

In some cases the garbage is plowed under in fields as fertilizer But the immediate value of garbage as fertilizer is far below what a chemical analysis might indicate because most of the plant food present is not immediately available as such It must first go through a long process of decay And then if the garbage contains much grease, this may clog up the pores of the soil with the effect of stopping the free circulation of air and water, and thus the garbage may even become a detriment to the soil

Incineration is one of the oldest methods of garbage disposal, and in many respects one of the most promising This hypothetical new Moses of the Garbage Can might well take a lesson from the Moses of old, for it is recorded that during the exodus from Egypt Moses ordered that all offensive and unclean waste be taken outside the camp and burned

Moses, however, would have wondered at the modern incinerating plants which not only provide a sanitary method of garbage disposal but by burning the garbage under boilers develop energy in excess of the needs of the plant The amount of energy available is not great because most of the steam thus generated must be used to dry the garbage before it can be burned However, steam from such a plant operates a pumping plant for the city of Milwaukee, and the city of Savannah pumps part of its water supply in this manner There is at least one small installation where this excess steam is turned into electric energy

The chief difficulty with incineration is that the fumes from the burning garbage are likely to create a public nuisance. The city of New Bedford, Mass., recently had an experience of this sort New Bedford until recently disposed of its garbage by reduction, but when the plant began losing large sums of money, an attempt was made to economize by installing a dryer so that garbage could be burned under the digester tank boilers The fumes inspired such a protest from citizens that the plan was quickly abandoned

Incinerating furnaces for the purpose of disposing of garbage with no idea of deriving therefrom any useful product or energy have been highly perfected They consist usually of a coal fire beneath a grate on which the garbage is spread to dry, the dried material finally being fed into the fire and burned

To the potential Moses of the garbage can the writer has these suggestions as to methods of attacking the problem of economical garbage disposal

1 Find some new use for garbage grease so that there will be a steady market for this product

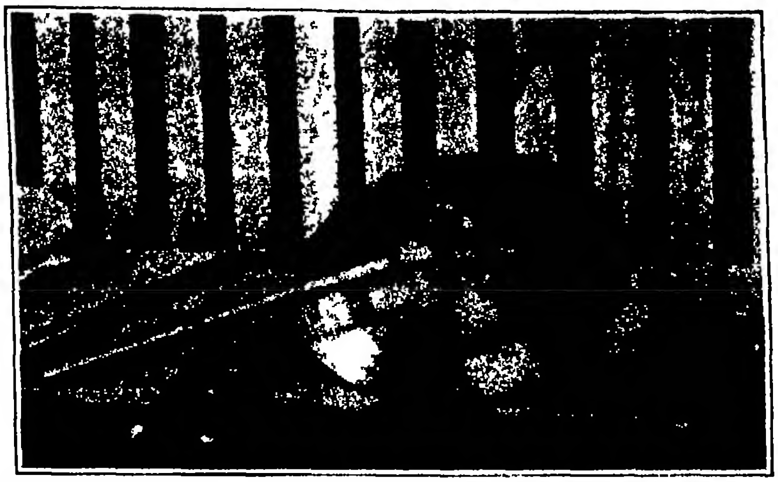
2 Find a method of overcoming the fumes from burning garbage so that the excess calorific value of garbage might be turned into useful energy without creating a nuisance

3. And, failing in these, find a way to convince a most skeptical world that any method of garbage disposal not yet tried is worth trying.

Aerofoil Data

A RECENT paper of the National Advisory Committee for Aeronautics, "The Minimum Induced Drag of Aerofoils," by Max M Munk, helps to explain the phenomenon of flight It contains some theorems concerning the arrangement of airplane wings which are of considerable practical interest. In particular, it shows the theoretical reasons for the decrease of drag which accompanies all increase in the aspect ratio or lateral extension of a wing The efficiency of a given arrangement of wings may be calculated from the formulæ in this paper.

A copy of this paper, which may be ordered as Report No. 121, may be obtained upon request from the National Advisory Committee for Aeronautics.



New timing disk for airplane motors, B and C are the thumbscrew and flange, by means of which it is attached and operated

New Timing Disk Reduces a Day's Work into a Few Minutes

OBVIATING the removal and replacement of propellers radiator shells and radiators, the labor-saving feature of a new timing disk designed and built by the engineering department of the United States Air Service at Post Flying Field Fort Sill, Oklahoma merits immediate recognition and widespread popularity Specifically the instrument was invented for use on Liberty motors, but by slight modifications it is adaptable on airplane engines of any design The spindle of this disk is provided with tapers and an expansion feature, adjustable to fit into the hub of all Liberty motors.

The expansion of the spindle is possible by thumb screws. Freedom to revolve around the spindle is permitted the disk itself until the flange is screwed up jamming the disk against the back flange which is stationary on the spindle Pointers are adjusted 45 degrees apart, indicating the center line of piston travel Washers and nuts secure the indicator into position Vertical position for the indicator is insured by a pendulum rod For the sake of convenience, the indicator is cut into three sections and the ends are threaded so these will screw into another It can be assembled in the absence of wrenches or tools. The disk is marked every 120 degrees, the notation being the point of top dead center, the crank shaft having three throws of 120 degrees Valve and ignition timing is checked by calibrated degrees on each side of these 120-degree marks.

Instructions from the Air Service include specific directions for using this timing disk The tail of the ship is raised not an absolute requirement, but one giving the pendulum of the instrument full action The spindle is shoved into the hole of the propeller hub the adjustable screw being turned until a tight fit is insured Forthwith the thumbscrew is relieved and the flange is screwed back, thereby permitting the disk to circumvent the spindle The removal of at least one spark plug from each cylinder facilitates turning of the propeller The top dead center of a cylinder say, No 6 is then discovered by inserting a pencil or scale into the spark plug hole and turning the propeller until the piston by upward stroke touches the pencil or scale and causes it to ride up Continue to turn the engine over slowly until the piston, as directed by pencil or scale stops moving upward and is about to start downward—marking this point on the pencil Approximate top dead center is thus vouchsafed

The propeller is now turned over in a forward direction until the pencil or scale has moved down so that the mark is even with the top edge of the hole, using the pencil in marking the disk in line with one of the pointers. The engine is given a backward motion until the pencil has moved up and down until the mark is again even with the spark plug hole the disk being marked in line with the pointer A pair of dividers will reveal the point between the two pencil marks on the disk Such point denotes the exact dead center of Nos 1 and 6 cranks, the propeller being turned until the point just discovered is under the right pointer Without moving the propeller the flange is loosened as well as thumbscrews, and the disk is turned by hand until one of the 120-degree marks coincides with the pointer Screw down the flange and thumbscrews and actual operation is in order Subsequently all the knowledge essential in timing the motor is that of recognizing when the valves open and close with reference to top and bottom dead center Once having timed the motor, the disk is subject to removal by loosening the expansion screw and extracting the spindle from the propeller hub. Former designs of timing disks involved a day's labor, whereas the recent invention accomplishes an equal task within a few minutes.

Elevator Interlocks

IN connection with the safety work of the Bureau of Standards, a survey has been made of many elevators located in several large cities with an idea of analyzing elevator accident statistics as bearing upon the use of safety interlocks. It has been shown that 73.8 per cent of all fatal accidents in connection with elevators which have doors to the shafts could be eliminated by the use of well designed interlocks The report has been prepared in the form of Technologic Paper No 202 of the Bureau of Standards, Washington D C

How Sensitive Is Dynamite?

MINING coal—hazardous occupation that it is—involves the use of explosives in tunneling for the winter's fuel supply Frequently a cartridge of explosive becomes lodged in a drill hole and in forcing the charge of nitroglycerin or other form of dynamite to the base of the opening ramming may be resorted to an exigency that is likely to result in premature combustion unless the frictional resistance of the particular explosive is known Such advance knowledge may now be ascertained by consulting a machine designed by the United States Bureau of Mines and adapted for use at its explosive experiment station near Bruceton Pa.

A shoe a pendulum and an anvil are the three essential parts of the apparatus which lend themselves to easy introduction to the layman in a new guise The swinging steel shoe, which may be shod with hardwood fiber or a product of more forceful impact exerts itself in a pendulum-like fashion from varying heights on a steel anvil which contains and exposes the charge of explosive Smooth faced like the anvil of the immortal village blacksmith to the extent of having a surface 3½ inches wide and 12 inches long, in the middle are to be found three grooves for holding the object of the test The steel shoe has a sway—that is a radius of swing—of 6 feet 6⅜ inches and the curvature of its beardless face is 10¼ inches Weights ranging from 22 to 44 pounds are employed in varying the force of the blow the shoe being dropped from heights of 19 7 to 78 7 inches Some explosives have yielded to the impact of the shoe when shod with wood fiber, while other combustible material is less sensitive even when pounded with harder substances.

Explosives recognized for use in mines, according to the 1920 permissible list of the Bureau of Mines, number 179 as compared with 162 in 1919 Thirty four new explosives were admitted on the approved schedule while 17 previously sanctioned were stricken from the list A digest of the rules, regulations, and practices governing the testing of explosives has been prepared, and all may obtain the report upon application to the Pittsburgh Experiment Station of the Bureau of Mines, Pittsburgh, Pa

Pendulum friction machine for determining the sensitiveness of explosives

New York's Proposed Belt Railway

Substituting Direct Rail Connection for Costly Car-Float and Lighter Transfer Between Rail, Warehouse and Dock

By William J Wilgus

COL WILLIAM J. WILGUS, for many years chief engineer of the New York Central Railroad, was responsible for the planning of the vast system of docks and railroads in France, which made possible the great effort of our Expeditionary Army in 1918 His long experience in the broad fields of railroad communication and terminal and dock facilities gives special emphasis to the present article Today the transferring of a car of freight from the Jersey City yards to the consignee in New York costs as much as it does to bring that freight from points five hundred miles or more inland These conditions affect the interests of the people, not only of the port of New York but of practically every city throughout the United States —EDITOR

THE problems of New York are of more than local concern they are of grave moment to the entire nation of which this port is the leading gateway to the markets of the world Evils in its midst clog the free movement of traffic place a burden of waste and delay on the country's foreign and coastwise commerce and seriously handicap the interior states in their struggle to dispose of their products at home and abroad Moreover whatever tends to block this portal also injures its efficiency as a means of national offense and defense in time of war and adds to the expense of operation of the rail and water carriers in which the country is so deeply involved

That such evils do exist is an acknowledged fact As far back as 1900 Theodore Roosevelt then Governor of the State of New York recommended that prompt action be taken to remedy them and several years later one of the Interstate Commerce Commissioners referred to the port as the sore spot of the nation It took the World War however to convince the public generally that something must be done to cure them

The reason why these faults have been permitted to grow until they are a menace to the future of the port is not difficult to find It is a clear case of neglect to keep in pace with progress in the art of transportation For more than two centuries its location on an island in the midst of a magnificent natural harbor and at the mouth of a great river that penetrated the hinterland was ideal for the sailing vessel and canal boat but with the advent of the steam railroad that which was originally an advantage gradually became a positive detriment to trade with the interior Railroads from the south and west came to the water's edge and found a barrier that could only be passed by transferring their loads to water craft and then retransferring them to land on the other side It was not practicable to lay the car alongside the ship nor uninterruptedly to move the car to its final destination All this entailed additional switching of cars and break of bulk with their attendant use of valuable waterfront lands and the employment of lighters and car floats for completing the rail haul In consequence piers for ocean going vessels, then of comparatively small size were built on Manhattan Island without provisions for tracks and of dimensions utterly unfitted for economical operation of the modern steamship

In the earlier years of the new era of transportation this was not found to be a serious disadvantage but conditions changed with the enormous growth of traffic and the marked increase in the size of ships Some 75,000,000 tons of railroad freight now pass to from and through the port each year and in so doing must cross the congested surface of the waters that separate the various parts of the city from each other and from the mainland on the west

The wastefulness of this process can be best illustrated by comparing it with the confusion delays and excessive costs that would reign in a great railroad terminal where different gages of the main line and yard tracks would necessitate the transferring of car contents and car bodies in transit within sight of their final destination a condition too absurd for serious consideration

Another development has accentuated these evils namely the phenomenal industrial and commercial growth of the New Jersey shore brought about by the presence of the railroad terminals on that side of the water What once affected the City of New York alone now is a matter of the utmost concern to the two states whose dividing line is the middle of the Hudson River and the Kills, from the southern tip of Staten Island to the northern limits of The Bronx

Thus it will be seen that with the mutations of time three elements have conspired to threaten the continued preeminence of the port of New York

(1) The apathy of its citizens who like the fabled hare have not realized that in greatness lurks the seed of its own decay—an overweening confidence in the maintenance of supremacy without effort

(2) The presence of a physical barrier of the first magnitude between the rail terminal on the New Jersey mainland and the island city of New York and

(3) The existence of the boundary between the states which politically separate the two parts of a common port

Of these the first and last are the hardest to overcome

Happily, the outlook is bright for remedying these evils, provided words are promptly and effectively translated into action For instance there is widespread recognition of the need for reform if New York is to hold her own in competition with rival routes including the proposed Great Lakes—St Lawrence ship canal project Also the two states are uniting in the building of a unique twin bore tunnel beneath the North River for affording vehicular access between lower Manhattan and Jersey City Furthermore laws have been enacted by the two states creating a port authority for the unified improvement and administration of the port as a whole which suitably amended in the future should accomplish its high purpose Finally a New York State law has been passed which directs the City, within two years to start the construction of a freight and passenger tunnel under The Narrows between the boroughs of Brooklyn and Richmond (Staten Island) the rental for which shall be sufficient to pay interest charges and amortization

It is with the last mentioned project that this article has principally to do as the requirement that the tunnel shall be self supporting has forced the City to look beyond its borders for prospective users—the railroads that serve the port—all of whom, it is believed may be brought to the portals of the tunnel if it can be shown to them that the advantages of so doing will warrant their uniting in the building of a Metropolitan Belt Railway that will put them all in direct rail communication with each other and with all five boroughs of the city

It will at once be seen that a facility of this kind will bypass a large proportion of the enormous tonnage that now wends its painful course through the congested heart of the port and thereby obviate many of the evils to which reference has been made

With this object in view a tentative location has been selected for a modern double track easy grade railroad which leaves the West Shore Railroad near Haworth in the rear of the Palisades, and runs thence west to the vicinity of Paterson thence bends south and follows the rural valley of the Passaic River, thence turns east and tunnels through the Orange Mountains at Short Hills, thence again curves to the south and skirts the easterly foot of the mountain escarpment as far as Scotch Plains thence takes a southeasterly course through South Plainfield and Metuchen to Perth Amboy where Arthur Kills is crossed on a high level viaduct with ample clearances for ocean going vessels, and thence northeasterly bisecting Staten Island, to a connection with the proposed tunnel route at Richmond Yard where the transition is proposed from steam to electric operation From this point the line dips under the high ground on the north shore of the island connecting en route with the new city piers at Stapleton, plunges beneath the Narrows where that channel swells into the Upper Bay and rises to a connection with the Long Island Railroad and the projected Brooklyn water front railway at Bay Ridge, Brooklyn

By means of trackage over the Long Island Railroad and the New York Connecting Railroad access is proposed to the new port developments at Jamaica Bay and Flushing Bay on Long Island, Moreover, by means of trackage over the New York, New Haven and Hartford Railroad and a proposed new crosstown connection between the Bronx and Manhattan the plan is rounded out and all the railroads on both sides of the state boundary are brought into rail contact with each other and with existing and proposed future improvements in all five boroughs of the city of New York and in the growing industrial regions of New Jersey

The tonnage already in sight for this project is between 20,000,000 and 25,000,000 tons annually, without including the anticipated great volume of traffic that is confidently expected to flow from partially completed and proposed new port and industrial facilities The annual saving in cost of handling such a vast traffic by this direct all-rail route, instead of the existing tortuous combined rail and water routes, is estimated to be far in excess of fixed charges and amortization on the required new investment, liberally estimated at something less than $150,000,000

Just the manner in which this comprehensive plan may be realized is a matter of negotiation between the city of New York and the railroads. The outstanding success of the Terminal Railroad Association of St Louis has prompted the suggestion that a similar agreement should be made between all the railroads of the port under which they would jointly construct the portion of the proposed railway that lies in New Jersey jointly lease the sections that are within the limits of the metropolis, and afford service to the users of such joint facilities at rates that will guarantee the payment of operating expenses and fixed charges, and no more

The experience of other ports and important commercial centers is in harmony with the claims that are made in behalf of the plan here set forth Montreal, Philadelphia Baltimore New Orleans, San Francisco and Chicago, as well as St Louis all voice the decided opinion that the belt railway is the backbone of their transportation layout, and essential to their success

So there appears to be every reason why the railroads should unite with the city of New York in taking advantage of the Narrows tunnel act to remedy many of the evils from which the greatest port in the world is suffering by reason of its physical disabilities The careful detail analysis that has been made of the proposed belt railway demonstrates that the project will much more than pay its way out of savings, and in addition bring many priceless benefits to a variety of interests.

The port as a whole, including the railroads that serve it, will profit from the removal of abuses that threaten to divert trade to rival routes, the city of New York, in all its boroughs, will enjoy the advantage, now denied it, of direct rail contact with all the railroads of the port, with resultant stimulation of dormant areas appreciation of property values, growth of trade and commerce, and lessened congestion, delays and cost in connection with the supply of food and fuel the commercial, manufacturing and shipping interests will gain through better liaison between the car and the facility it serves and the federal Government will secure improved prospects of modern terminals for its merchant marine the surety of more economical operation of the railroads in which it is vitally concerned and a valuable factor in defense of the city and nation in time of war

Too much emphasis can not be laid on the last item During the World War it is a matter of common knowledge that Paris, and therefore the allied cause was saved on several occasions through the presence of the Grande Ceinture (Outer Belt) over which troops and supplies were poured from many directions to crucial points without having to pass through congested centers Certainly we do not wish again to find ourselves some day in Washington's predicament when he lost the Battle of Long Island in 1776 Our national safety demands that means should be provided without delay whereby for *defensive* purposes a modern army with its supplies may be quickly drawn from many points in the interior and concentrated on Long Island or on the north shore of Long Island Sound These same means in the case of *offensive* operations will spare us from the possibility of disaster which came so near to us when the existing facilities at New York broke down during the late war

Certainly the need for this great engineering work is urgent in the extreme and calls for effective action by all the interests named in support of the start that has been so promptly made by the city of New York in compliance with the mandate of the State

Map of Greater New York, showing how the proposed Belt Line will intersect the railroads coming in from the South and West. This will render it possible to run a carload of freight direct from points inland to any pier or warehouse in New York, thereby effecting a great saving in time and labor over the present system of transfer by car-float and lighter

Studying the Flight of Flies

THE marking and release of 234,000 flies by expert Government entomologists in order that these scientists might study in detail peculiarities in fly behavior which previously had never been investigated thoroughly is one of the most remarkable undertakings and accomplishments of recent years so far as bugologists are concerned Federal representatives of the National Bureau of Entomology have officiated as modern fly cops and insect detectives in these novel experiments whose objects have been to determine how various species of economic insects were distributed and how knowledge concerning the intimate daily doings of the winged pests could be used advantageously in developing efficacious control and eradication measures The varieties of flies which affect man and animals are largely distributed by natural dispersion through ordinary flight

These unique fly tests were started in order that practical data might be had which could be interpreted in terms of the spread of fly borne diseases as well as to provide accurate data regarding the proper location of dumps incinerators hog feeding stations and other favorable fly breeding grounds so that the menace to surrounding towns cities and rural districts would be avoided House flies may travel anywhere from one mile to 50 or even 100 miles in their journeyings about Observations made at the Rebecca Light Shoal off the coast of Florida show that flies occasionally migrate to that point from Cuba a distance of 95 miles while fly visitors from Key West only 40 miles away are relatively common

The federal fly investigations have been carried on chiefly in northern Texas The flies were captured by baiting large conical fly traps with packing house products of strong odor The traps were exposed in places which teemed with flies for anywhere from 1 to 24 hours and then screened cylinders were placed around the fly traps, the covers of the traps were removed and then they were agitated until the flies were driven into the cylinders. The free ends of the cylinders were then covered with cheesecloth and they were conveyed expeditiously to the point of liberation where the cylinders, one at a time, were slipped into a special canvas bag containing one or two ounces of finely powdered red chalk or paint pigment, which was thoroughly sprinkled over the captive flies so as to mark them definitely for future identification The flies were then liberated Yellow chalk and rosalic acid were not satisfactory for marking the flies, red chalk and red pigment being the best materials for this purpose

The flies flew away immediately after release from their paint box prisons most of them speeding with the wind or at right angles to its course In order to ascertain the distance of dissemination a large number of conical traps 18 inches in diameter were placed at varying distances in different directions from the points of liberation These traps were baited with strong smelling by products which would attract the flies The flies collected in these recovery traps were killed daily and counted and the number of marked flies determined In case the coloring matter could not be seen with the naked eye microscopes were used which invariably would favor the identification of all the experimental flies in each lot It is notable that over 64 per cent of the total number of marked flies recovered were captured again within 24 hours after liberation Most of these flies previous to capture traveled at right angles to a wind that was traveling at a velocity of from 13 to 24 miles an hour These experimental results show that for some unexplained reason the flies of all species failed to be recovered in the traps south of the points of liberation in numbers in proportion to those recaptured in the traps placed in the other directions. These tests also showed that the flies travel with a fair degree of speed as they cover the first 1000 feet from their place of release in a few minutes. The common house fly will cover from 5 to 9 miles about two days immediately after release The tendency of the flies was to travel in a westerly direction, 77 per cent of them being recaptured in traps placed in that direction

The stimuli which was largely responsible for the wide dispersion of the house flies were the desire for food and the desire for places where eggs could be deposited The fact that in their flights the house flies passed many towns, farms and other favorable places for feeding and breeding indicates that they possess marked migratory habits

Lessening Lumber Losses

Some of the Ways in Which Wood Wastes Are Saved and Put to Work

By George H. Dacy

THERE are two ways, and only two, in which we can continue to meet our wood requirements says Uncle Sam. One of these is to grow more wood, the other alternative is to use more effectively the supplies now available. We must see that our remaining 137,000,000 acres of virgin forests are cut in such a way as to maintain the productivity of the land and that our 81 000 000 acres of wholly idle, and our 235 000 000 acres of partially idle forest lands are put to work. Furthermore we must see that, of the 24 billion cubic feet removed from the forests each year, 70 to 75 per cent no longer goes to waste in the form of sawdust shavings and other mill refuse—that more than 25 to 30 per cent is put to some use.

Creosoting posts, poles and railroad ties to prevent decay

It is only during the last few years that any great amount of technical and scientific study has been devoted to wood in this country. Thousands of experts previously had devoted their energies to the solution of problems related to steel, concrete, oil and rubber industries, but wood which was more complex and intricate than any of these was neglected. Hence about a decade ago Uncle Sam and his skilful foresters, appreciating the vital need for more knowledge about wood, plunged into the task of research and investigative work in search of knowledge nuggets which would permit of our more efficient utilization of our timber supplies. The results are that more than a half million tests have been made on 149 different kinds of native woods at the federal Forest Products Laboratory at Madison, Wisconsin. These make it possible to substitute accurate facts and figures for previous guesswork in utilizing wood for the thousand and one purposes for which its strength, elasticity, toughness and other mechanical properties adapt it. In some cases this means merely finding a use for something always heretofore discarded, in others it involves actual new processes of treatment extending the use of a particular variety of wood.

Grading rules for the building trades have been worked out as a result of experiments on the strength of southern yellow pine and Douglas fir which now make it possible to secure as great structural strength in construction by the use of 20 per cent less material than was formerly employed. This discovery alone means a saving of about $10,000 000, if all contractors will practice it. Formerly, untold millions of feet of valuable hickory have been wasted because the handle and spoke manufacturers have assumed erroneously that the red heartwood was inferior to the white sapwood. Government tests have demonstrated the error of this assumption and have effected great savings in the hickory industry.

Heretofore, time and money have been wasted in drying and seasoning green lumber by natural air exposure methods. The federal foresters have speeded up these long-drawn-out natural processes of curing by the mechanical use of dry kilns, and now more than 85 different kinds of woods such as Douglas fir, spruce, southern yellow pine, gum and oak can be dried in short periods at low cost. An annual saving of more than $5 000,000 has already been effected despite that the use of the new methods is still infantile in extent as measured in terms of the countrywide industry. For example, it used to take one to two years of air drying to season Douglas fir so that it was adapted for certain manufacturing uses. Now this work can be accomplished under kiln drying systems in one month. In other industries, kiln drying has reduced the loss of material from 60 per cent to less than 2 per cent, while shortening the seasoning period at least 40 per cent.

A heavy call on our available forest stocks is made annually in the replacement of decayed railroad ties, mine and bridge timbers, poles, posts, piling and other wooden material of large sizes exposed to constant weathering. There are now more than 85,000,000 railroad ties in use in this country which have not been treated with protective overcoatings of creosote, zinc chloride, or other suitable preservatives in order to protect them against decay. Forest Service tests show that untreated crossties only last an average of 7.5 years, whereas treated ties are serviceable for 15 years or longer. If all railroad ties used in this country were annually treated in this manner—the cost per tie is not large—a saving of more than 1,500,000,000 board feet of valuable hardwood lumber would result. If all wood used in the United States which is exposed to decay were similarly armored, the annual saving would aggregate over 6,000,000,000 board feet, equivalent to 20 per cent of our annual lumber cut. This would go a long way toward saving our forests.

About 15 per cent of the annual lumber cut is now used in making boxes and crates, the bulk of which are unsatisfactory in shape, size or strength. The National Forest Service has devised efficient testing methods and systems of standardizing these containers so that a good many millions of dollars worth of freight will be rescued from repetitions of previous disasters during transit, while large amounts of lumber which previously have been wasted—so far as satisfactory container service was concerned—will be saved. During a recent year, our domestic railroads paid out over $100,000,000 for freight lost and damaged during shipment due to faulty boxes and crates. White pine alone formerly was used largely for containers, but now as a result of government experiments, 40 different kinds of wood are used, many of which are thinner and stronger and reduce car and cargo space from 10 to 40 per cent—to say nothing of the direct economy of material.

As a result of the prevalent practice of cutting small dimension material from finished lumber instead of from the logs, large wastes occur in the handle, spoke, chair, furniture, toy and agricultural implement industries. In the furniture business, from 40 to 60 per cent of the raw lumber is frequently wasted. Some hickory handle factories report that not infrequently it takes two tons of lumber to produce 400 pounds of satisfactory handles. Experts say that a saving of about 6,000,000,000 board feet a year can be effected if only all the lumber which is now wasted by the industries could be saved and used as small dimension stock.

Left: Douglas fir wing-beams for airplanes being kiln dried and seasoned in thirty days, against two years required by old processes. *Right:* Pickling posts in creosote to protect them from the ravages of insect pests

Making our supply of wood stretch out further than in the past

The potentialities presented by the perfection of built-up methods of construction—discovered and improved by the U. S. Forest Service—indicate one practical means of plugging the largest leak in the field of wood utilization The history of the average saw log is prolific in tales of waste from the time the tree is felled Mr S. T Dana, prominent forest economist says in this regard "Of the wood in the forest, some 25 per cent is now lost in the woods, 40 per cent at the mill, 5 per cent in seasoning and from 5 to 10 per cent in converting the raw lumber into the finished product Moreover, the replacement of our magnificent virgin forests by small sized, poorly formed, often defective second-growth trees is making it increasingly difficult to secure high grade material The problem is to ascertain some way of utilizing the 75 per cent now wasted and of making the low grade material from our inferior second-growth forests do the work for which high-grade material has heretofore been regarded as indispensable Built up construction, by making possible the use of odds and ends from low-grade lumber, slabs, edgings and other material now wasted may furnish the answer One of the striking features about built up products is that if properly made they are not only fully as serviceable as similar articles made of solid wood, but that the glued joints are ordinarily stronger than the wood itself Their chief weakness rests in the fact that when they are constantly immersed in water or subjected to alternate drying and wetting, they must be made of waterproof glue, a material which does not yet exist"

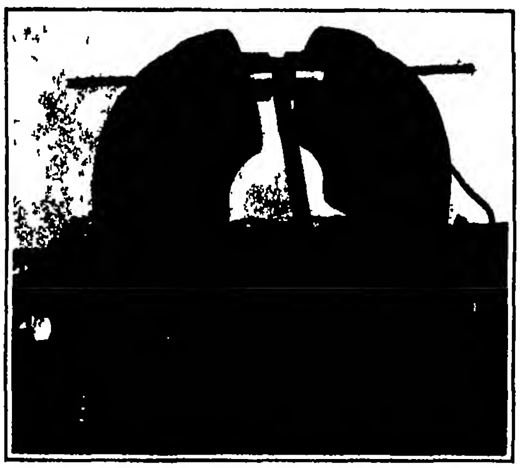
Wood is the most wonderful material in the world if the diversity of products emanating from it is any basis for judgment Products derived from wood are now being employed in the manufacture of news and writing paper, linoleum, artificial silk, gunpowder, paints, varnishes, soaps, inks, celluloid, sausage casings, acetylene, chloroform and iodoform Again the writer quotes Mr Dana, who told him that 90 per cent of our paper supply is now made from wood "The paper industry employs 110,000 persons, has an annual output valued at $850,000,000, and consumes each year over 6,000,000 cords of wood, the product of more than 1,000,000 acres of forest Over 60 per cent of this is spruce, and the majority of the remainder hemlock, balsam and poplar In the wrapping paper field, methods for utilizing the southern yellow pines, hitherto regarded as unsuitable for the commercial production of paper pulp, have been developed and the industry established. One of the largest lumber companies in the South is now turning its woods and mill waste into paper pulp at the rate of 60 tons a day Recently marked progress has been made in working out methods to enable the use of southern pines, such as shortleaf, in mixture with hardwoods such as red gum for the production of book paper, and already these methods have been introduced into one extensive mill"

Studies are now under way under the direction of the U S Forest Service designed to consummate the potential salvage of material worth more than $16,000,000 now lost each year through the decay of pulp wood and wood pulp while in storage. Another avenue which promises partly to cork up the annual drain on our forests for wood pulp emanates from the use of hull fiber and second-cut cotton linters and their utilization for paper pulp purposes. Experiments have shown that these materials, of which there are about 200,000 tons available each year, can be converted into high grade paper Several large plants are now engaged in this work, their daily production amounting to 800 tons with a sale value of $15,000,000

Wood alcohol which is indispensable in several chemical industries is made by the destructive distillation of wood Acetate of lime also obtains from the process and gives rise to the production of acetic acid, acetone, acetic ether and similar materials. Small and crooked trees, limb wood and slabs are used for the production of wood alcohol whose manufacture furnishes a profitable disposition for these misfits of the timber tract. The by-product of the distillation consists of charcoal which is used as a fuel as well as in the smelting of iron, tin and copper, in the manufacture of gunpowder, as an insulating material, and as a clarifier in sugar refineries.

Formerly birch, beech and maple were considered as the only satisfactory woods for the making of wood alcohol, but recent investigations have demonstrated that oak, gum, elm, ash and hickory are just as efficient for this purpose. The methods of distillation have now been greatly improved and the amount of alcohol obtained from a given amount of wood has been increased from 10 to 15 per cent by better control of the temperature and the use of less fuel Fifty per cent increased yields of alcohol have recently resulted by adding sodium carbonate in the form of chips or sawdust briquettes to the wood

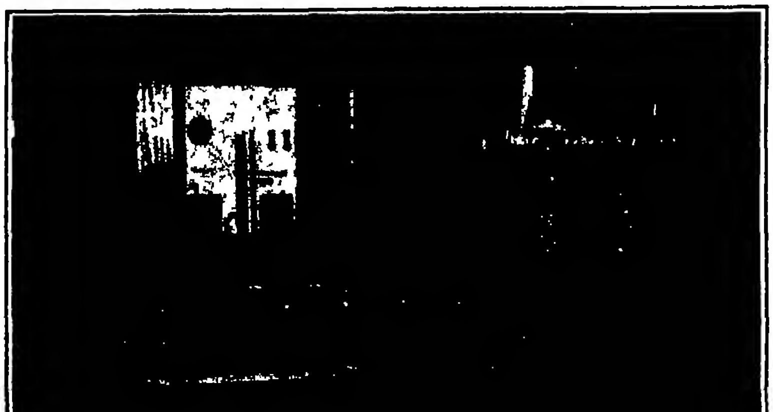
Mechanical glue-spreader used in the manutacture of plywood



New apparatus for studying steel under the influence of an intense magnetic field

The naval stores industry can be saved only by perpetuating our forests, but it can be prolonged by devising methods of tapping which will give larger yields with less injury to the trees. A new system of tapping developed by the Forest Service experts has already effected a saving of more than $1,000,000 a year Under this system, 20 per cent more gum can be obtained, the deterioration of the timber is much less and the danger from fire is greatly decreased Potentially, it is anticipated that present methods will be so modified that the lives of the trees will be greatly prolonged

Sawdust and mill wastes can now be used on a practical scale in the manufacture of grain alcohol, the sawdust being hydrolized by treatment with a weak acid and then cooked so that its cellulose is converted into sugar Yeast is then added, which ferments the sugar and finally produces alcohol which can be separated from the rest of the solution by distillation One ton of dry, coniferous wood like Douglas fir or southern yellow pine will yield from 20 to 25 gallons of 95 per cent alcohol Chemists and foresters predict that shortly grain alcohol will be one of our important motor fuels. Already some resort to this ethyl alcohol for motor fuel has been made as our gasoline supply decreases It is estimated that more than 300,000,000 gallons of this alcohol could be made from the wood material now wasted annually at American mills Small trees and low grade material could also be devoted to this use It may be that the time will come when trees will be grown in planted forests for the specialized production of grain alcohol for use in automobiles This would be but the logical outgrowth of the day's advances in chemical technology



Investigating the chemical basis of tanning in the world's smallest tannery

Magnetic Testing of Wider Applicability

THE flaming forge of the village blacksmith shapes the piece of steel in response to the needs of the moment Nobody doubts the pliableness of the metal when subjected to intense heat, but probably few reason that the specimen of steel undergoes marked changes in character while the hot flames are being applied All by way of suggesting that steel is an interesting subject for study and that scientists have not said the last word on metallurgy

The development of new apparatus by the National Bureau of Standards lends emphasis to the theoretical study of steel under the influences of intense magnetic fields. Its accommodations for making magnetic measurements of relatively long straight bars of iron or steel in intense fields is the distinguishing characteristic of this device as compared with other similar apparatus. The projecting bars evident in the illustration reproduced herewith emphasize this novel virtue Heretofore the length of the test specimen was restricted by the testing mechanism itself By the use of this apparatus it is possible to carry the magnetizing force to a sufficient degree to determine the saturation intensity of magnetization of long bars.

The apparatus is composed of an electromagnet of the Du Bois type with flat pole pieces These are separated by an air gap of 2 centimeters and pierced coaxially so that a rod 6 millimeters in diameter and several centimeters long can be extended through them as well as the electromagnet The test specimen is surrounded by three coaxial coils wound on brass forms, each 1 centimeter long and having external diameters of 7 millimeters, 10 5 millimeters, and 13 2 millimeters, respectively Each coil has 100 turns of No 40 enameled copper wire Insulation from the brass forms is guaranteed by the enclosing of the latter in a thin sheet of paper reinforced by having the whole coil, after winding, shellacked and baked in an oven at 100 deg Centigrade for several hours.

This apparatus should prove useful in applying magnetic analysis in the theoretical study of iron and steel The device will not displace other serviceable apparatus, but constitute an additional method for studying the physical properties of steel The Bureau of Standards is now engaged in studying the correlation between the magnetic and mechanical properties of steel—*By S R Winters*

A Tiny Tannery

THE world's smallest complete tannery has recently been constructed by Prof A W Thomas of Columbia University, New York Barely two and one-half feet long, raw hides can be fully and most scientifically tanned in this invention Professor Thomas built this tiny tannery, which is believed to be the only one of its kind in the world, with the object of making a careful and scientific study of the fundamental chemical action of tanning, in other words, to find out just why certain chemicals acting upon the raw hide tan it into serviceable leather Curiously enough, although the process of tanning has been understood for generations, we have yet to learn the chemical why of it

The Latest in Steel Rails

Doubling the Life While Increasing the Cost Only by Twenty Per Cent

By Frederic C. Carl

EVEN the layman whose interest in metallurgy prompts him to try to keep posted on this subject must have met the terms austenite, martensite, troostite, sorbite, pearlite, ferrite, cementite, and perhaps a few other -ites of one sort or another Nobody, we believe, is entirely clear as to the hows and whys and wherefores, and particularly as to the precise whats, of these substances; but we are learning every day. And in the learning we are putting on a very solid basis of scientific knowledge a lot of things which have never before been understood at all, or known in any sense other than the empiric. The heat-treater knew by bitter experience that some things he must do and others he must not, he had no idea why That great progress is being made in this essential department of engineering knowledge is evidenced by the fact that the makers of a new steel rail for which double life is claimed are sufficiently removed from the empirical to be able to christen their product "sorbitic" It is this sorbitic rail and its showing that Mr. Carl tells us of in the present story—THE EDITOR.

OBSERVANT strollers upon that favorite American promenade, the railroad track, may see on the web of an occasional rail, in addition to the usual other cabalistic letters, figures and signs, the raised letters "S S S,' near one end These letters are the initials of the words 'Sandberg Sorbitic Steel," a material now engrossing the interest of railroad managements, metallurgists and manufacturers in Europe and America

Five hundred tons of sorbitic steel rails, weighing 105 pounds to the yard, or enough to lay three miles of continuous track, have been laid since last February on the Spuyten Duyvil curve in the electric zone, and in numerous other curves, on the Hudson River and the Pennsylvania divisions of the New York Central Railroad In each instance, in accordance with the request of the manufacturers, the outer rail for one half the curve is sorbitic steel and for the other half of ordinary open hearth steel this in order that comparisons may be made under identical conditions in numerous instances.

Representatives of the railroad and of the licensees under the Sandberg patents keep these rails under observation. Contours of the rail heads are taken at intervals of three to six months. From the amount of metal worn the life of the rails can be determined and the relative merits of the new and old processes compared

At least two years will be required to reach definite conclusions, but experiments begun at a prior date on other American railroads seem to bear out the assertion that sorbitic steel will wear from two to three times as long as ordinary open hearth steel rolled at the same time from the same ingot With open hearth rails at $47 a ton, an additional charge of $9 a ton is made for the Sandberg process. An extra wear of 100 per cent or more for an increased price of 19 per cent would seem to be a most attractive bargain for frugal railroads.

In December, 1917, the Pennsylvania Railroad purchased an experimental lot of 130 pound rails made by the new process Some of them were laid in 3- and 4-degree curves on Turkey Hill, where they were subjected to a slow freight traffic aggregating 127,000,000 tons in two years. Numerous other American railroads, including the Lehigh Valley, Delaware & Hudson, Delaware, Lackawanna & Western, New York, New Haven & Hartford and Southern have ordered experimental lots of sorbitic steel rails varying in weight from 90 to 136 pounds to the yard The accumulated data from all these trials ought to be conclusive.

The manufacturers have also supplied a lot of the new process rails to the French State railways. In England, where the process originated, experiments with the Sandberg rail have been conducted for the last four years on several steam railroads and on more numerous street railways in the larger cities. The English are also experimenting with the Sandberg process for hardening what they insist on calling "tyres."

During the war an offer of the Sandberg process as a free gift to the British Government was accepted after exhaustive experiments by the Ordnance Committee, and the process was adopted by the Ministry of Munitions for the purpose of reclaiming high-explosive-shell steel which failed to meet specifications. The process was used extensively in England, Canada and the United States for this purpose, saving several million shell forgings which otherwise would have been rejected. In this way the Sandberg process was brought to the favorable attention of the corporation which obtained the right to use it in the United States.

The process is the invention of C. P Sandberg, a distinguished British metallurgist now deceased, developed commercially in response to an increasingly urgent demand for rails of a higher quality It is well known that committees of the American Society of Civil Engineers, the American Railway Engineering Association, the American Society for Testing Materials, not to mention the United States Bureau of Standards and a number of private investigators have been studying the rail problem for years. Section, chemical composition and details of manufacture from the open-hearth furnace to the cooling bed have been reported upon and argued about without limit and without satisfactory result, for every improvement in the rail has been promptly followed by an increase in the demands upon it.

Attempts have been made, both in England and the United States, to find a method of tempering rails economically, but the plan involved quenching the rail at a high temperature and then reheating to arrive at a given temperature The process was slow, very expensive, difficult to control and uncertain in results. The New York Central has 1,500 tons of manganese steel rails in service The Southern Pacific purchased 2,000 tons of manganese rails to lay in passenger tracks on mountain divisions. A number of other roads have also tried manganese rails on curves. Prior to the war the price ranged from $80 to $85 a ton during the war the quotation went up to $250 to $280 a ton, now it is around $180

Manganese rails are tempered by being quenched in water It is agreed that they will wear ten times as long as open-hearth steel, but their elastic limit is only 35,000 pounds Extra good wearing rails are not needed on tangents, but they are essential on curves. Rails of such low elastic limit, if hit by a locomotive at high speed not properly counterbalanced, might bend with unfortunate results.

An ideal method of manufacturing a rail which should at least satisfy present demands would not restrict the output, would not discard old plants or require elaborate new apparatus, would not unduly increase cost and would materially increase both safety and durability

The Sandberg process seems to meet all these requirements fully The additional apparatus required is nothing more than a section of pipe the length of a standard rail, pierced with holes three-sixteenths of an inch in diameter and spaced three-eighths of an inch apart As the rail comes from the hot saw, at a temperature of about 1,800 degrees Fahrenheit, at which the color is a deep orange, it is held close under this pipe while air at a pressure of 12 to 15 pounds plays upon the top and sides of the head for about three minutes, or until it has cooled down through the critical range to recalescence, when the temperature of the head is about 1,250 Fahrenheit. The rail then passes on to the cooling bed as usual. Two such pipes are sufficient to treat 20 per cent of the output of the big rolling mill at Steelton, near Harrisburg

Steel in a sorbitic condition has long been known to give maximum hardness and strength combined with toughness, a high elastic limit and resistance to shock. A sorbitic structure is therefore aimed at in the metal for gun forgings and other high class work Sandberg's contribution to the art was a practical method for treating rails to attain this structure.

The effect of the Sandberg treatment is to develop a sorbitic structure in the upper surface of the head of the rail to a depth of about three-eighths of an inch, although it is claimed that the sorbitic structure is carried to a depth of about an inch in some instances. Sorbitic granules are so very fine that it is difficult to distinguish them even when enlarged 1,000 diameters. Photomicrographs show a marked contrast to pearlite with its distinct markings, the sorbite being a perfectly smooth black. Hardness is very greatly increased without increased brittleness. On the contrary the Sandberg treatment renders the steel more ductile.

In one test a rail was cut in two, one half being left as rolled while the other half was given the Sandberg treatment. Pieces 8 inches long were machined from the heads of the two pieces, then fixed in a chuck for abrasion tests. After 2,000 revolutions per minute for 20 minutes the pieces were measured by micrometer The untreated piece had worn away 1.35 millimeters, the sorbitic steel only .32 millimeter Under a sliding abrasion test, the nearest approach to actual wear to which a rail is subjected in the track, sorbitic steel showed a resistance of three to one as compared with untreated steel. By the Brinell test the sorbitic part of a treated rail showed a hardness of 300 to 350 as compared with 240 in the pearlitic structure of the web and base of the same rail Hardness by the scleroscopic test is 50 to 52 for sorbitic steel and 38 to 40 for ordinary open-hearth steel. Sorbitic steel has an elastic limit of 90,000 pounds and a tensile strength of 140,000 pounds with an elongation of eight per cent, as compared with 60,000 elastic limit, 125,000 pounds tensile strength and elongation of ten per cent for open-hearth steel

Another form of the Sandberg treatment for producing a sorbitic condition in the upper surface of the heads of rails in place has recently been applied rather extensively on street railways in London, Bournemouth, Manchester, Birmingham, Liverpool and Glasgow A four-wheeled push-car with hand gear for slow uniform movement, is fitted with a special acetylene burner for heating the head of the rail. When the proper temperature has been reached the head is cooled by a jet of water from a tank on the car

Photomicrographs of drillings at various depths show a progressive change in the metal At a depth of one-eight inch there is a sorbitic structure with a hardness of 600 on the Brinell scale, at a depth of three-sixteenths inch there is a change from sorbitic to pearlitic structure, at a depth of five-sixteenths inch normal pearlitic structure is found. The rails so treated become highly polished, showing the change in the structure. This process has the advantage of requiring no disturbance of the permanent way, but steam railroad men look askance at the mere suggestion of such heroic treatment.

Treatment by the Sandberg process at Steelton is such that the base and web of the rail are not affected Only the wearing surface and the sides of the head are tempered because those are the only parts subjected to wear The outer rail on curves is subjected to very severe wear for it has to resist the tangential thrust of the enormously heavy trains at high speed. The inner side of the head of the best open-hearth rail that the present state of the art can produce is soon badly worn and deformed, especially on a busy road like the Pennsylvania division of the New York Central Railroad with its traffic of 60,000,000 tons a year As at present applied the Sandberg treatment does not harden the sides as much as the upper surface of the rail head, and to that extent improvement seems desirable.

As sorbitic steel rails at an increased price are wanted only for severe conditions on curves under heavy traffic, particular care is taken at Steelton to insure good material Steel low in carbon is cast in very large ingots—25x30x96 inches, weighing 12,800 pounds. Then, to insure sound normal metal, the upper two rails from the ingot are discarded.

German Locomotives for Russia

AN article in the *Berliner Tageblatt*, dealing with the increasing activity in Russo-German trade, states that the Soviet Government recently ordered 700 railway engines, which German manufacturers have undertaken to deliver in six to seven months. The first cargo of six engines is already at Hamburg awaiting transport to Russia The Soviet Government has also placed orders in Germany for chemicals, agricultural machinery and rails to the value of a milliard and a half marks. The first deliveries of goods in payment from Russia have already arrived in Germany.

A Camera That Analyzes Motion

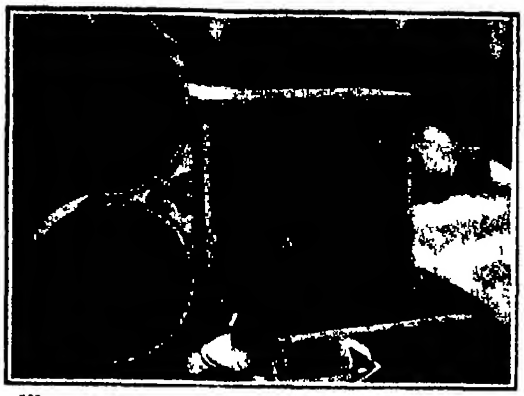
MOST unusual effects can be obtained by taking motion pictures at a high rate of speed and projecting them at the standard speed of sixteen pictures, or "frames," per second Such pictures show tennis balls and hurdling horses floating through the air, boxers gently and nonchalantly fanning and tapping each other, and so on. There are various special cameras for this kind of work—high-speed filming—but until the present their construction has been considered the deepest secret

A new speed camera for motion-picture work, designed to overcome the objectionable features of the makeshift devices heretofore used for this work, has been invented by a Pacific Coast man The chief characteristic of the new camera is a straight pull on the film With a camera capable of taking 14 feet of film (224 separate pictures or frames) per second, it will be readily appreciated that there is a terrific strain on the film, to say nothing of similar destructive influence on the camera itself.

With the film magazines mounted at the back, the new camera takes the film in a direct line to the aperture and in another direct line back to the take-up magazine, thus providing an instrument that has only one turn for the film.

With a turning mechanism that is geared very high, each turn of the handle exposes seven feet of film The handle is turned at the same rate as on an ordinary camera—two turns per second—hence to the operator there is no difference in manipulation.

Of course, when such a film is projected at the ordinary rate of speed, objects move very slowly, one step of a runner, for instance, taking ten seconds or more on the screen. This makes the instrument of incalculable value in scientific and industrial work.



Ultra-speed motion picture camera with case open to show straight pull action of film

Keeping Track of Surgical Operations

SURGERY, after all, is largely a matter of precedent. If one surgeon has met with success in handling a new kind of operation in a somewhat different manner than heretofore, his work immediately serves as a guide for other surgeons confronted with similar cases. So it becomes necessary to keep accurate records of various important operations without in any way interfering with the work of the surgeon and his assistants.

From Germany comes the interesting photograph shown in the lower left-hand corner, showing a new type of motion-picture camera especially intended for recording operations. The camera is mounted at the lower end of a long arm suspended from the ceiling of the operating room, directly over the operating table. The camera is carefully focused by looking through a sterilized periscopic sight, which also serves as a handle in aiming the lens. The camera is motor-driven, the necessary controls being placed on a small table to one side of the operating table.

A somewhat similar idea, although not of the recording character, is a reflecting projector device, which is also mounted over the operating table. The image of the operating table is projected on to a screen in another room, where it can be studied by students and others without disturbing the surgeon and his assistants.

Making a film of an operation by means of the new German motion-picture camera

Hot High-Nitrogen Gas in a Metal Mine

WHILE investigating the presence of heavy strata gases in certain mines of the East Tintic district of Utah, a small, local body of light, very hot gas of high nitrogen composition was noted in one of the mines. Observation and analyses indicate that this light gas was resulting from very rapid oxidation of finely disseminated pyrite, in lead silver sulfide ore. The gas was actually mine air which had lost a large proportion of its oxygen content by reaction with the pyrite This body of gas was hanging in a local high spot about 5 by 5 by 5 feet in size, caused by caving, at the end of a crosscut Fifty feet from this spot, an air current of 0000 cubic feet per minute was entering the 5 by 7 foot crosscut from a raise from below

On account of the vapor contained in the gas, the bottom level of the gas could be plainly seen and was practically a horizontal plane, but of slightly wavy appearance, coinciding with the point where an acetylene light was extinguished. This body of gas was visited on three occasions and samples obtained by means of evacuated bulbs and by water displacement The temperature of the gas was approximately 175 degrees Fahrenheit on all three occasions, so that sampling required thick gloves and quick action Air three feet below the vapor line had a temperature of only 120 degrees Fahrenheit, and a relative humidity of 27 per cent The stratification of the air and gas mixtures was so sharply defined that the sampler could hold his head a few inches below the vapor level for an appreciable period of time without any noticeable effect other than that due to high temperature. At one foot below vapor level, it was 135 degrees Fahrenheit, and the relative humidity was 30 per cent. When a candle and an acetylene light were raised into the gas from below, the candle flame was extinguished at a point two inches lower than the acetylene flame, indicating a drop in oxygen content from about 16 per cent to 12 per cent (oxygen content of normal dry air 20 93 per cent) in the distance of two inches.

The analyses and the air-free calculations made therefrom show that the gas is black damp (defined by Haldane, the English physiologist, as an accumulation of carbon dioxide and nitrogen in proportions larger than those found in atmospheric air) composed almost wholly of nitrogen The average analysis of normal dry atmospheric air is usually given as carbon dioxide (CO_2), 0.03 per cent, oxygen (O_2), 20 93 per cent and nitrogen (N_2), 79 04 per cent Included in the nitrogen percentage are the so-called rare gases of the atmosphere which constitute about one per cent of the total constituents of air, and, like nitrogen, are inert Mine air always differs slightly in composition from the above, but in mines as well ventilated as this particular mine, the CO_2 percentage rarely goes above 0.2 or the oxygen percentage below 20.5, even at points as much as a mile distant from intake openings.

The analysis showed that as the elevation increased from 12 inches above the vapor level to four feet above this level (and one inch beneath the roof), temperature remained fixed at 175 degrees Fahrenheit and humidity at 100 per cent, carbon dioxide content increased from 0 17 to 0.38 per cent oxygen decreased from 8.93 to 2 49 per cent, and nitrogen increased from 90 9 to 97 13 per cent The calculated air-free composition of the black-damp was 0 48 per cent or less of carbon dioxide and the balance nitrogen One inch below the visible vapor line, analysis of the atmosphere showed 0.17 per cent carbon dioxide, 20 27 per cent oxygen, and 79.56 per cent nitrogen—practically normal air. In every case, after the gas under analysis had been examined for carbon monoxide, hydrogen, and methane (CH_4), and none of them had been found, the nitrogen content was found by subtraction on the assumption that the balance of the gas was entirely nitrogen

That the process of oxidation was still in rapid progress was evidenced by the fact that, although the body of gas occupied not more than 150 cubic feet and the vapor level was practically constant, a thin stream of hot gas, estimated at 25 cubic feet per minute, was flowing along the roof of the crosscut to the air current 50 feet away

The tendency of such a mixture of air and gas to "hang" to the roof is due to its lighter weight as compared with the mine air The difference in weight is due primarily to the differences in temperature and humidity, rather than to the difference in chemical composition, since nitrogen is very little lighter than air

The gas had a strong, musty sulfur odor and had a suffocating effect when breathed Attempts to prove the presence of sulfuric acid vapor in the body of gas were not determinate, although a very slight amount was undoubtedly present The presence of this body of gas in this particular mine probably represents the first step in the production of certain heavy strata gases high in carbon dioxide content that affect mines in this district, that is, the production of residual atmospheres by oxidation of sulfides, accompanied by the production of heat, sulfur dioxide and sulfuric acid, the succeeding step being the production of carbon dioxide by reaction of the acid with carbonates present in the rock

Deposition of dehydrated iron sulfate had formed a border about one foot wide and one-half inch thick on the surrounding walls, the upper edge corresponding with the vapor level, while the walls in contact with the gas had a leached and porous appearance A sample of the material (pyritic lead silver sulfide) from the wall in contact with the gas analysed 7 8 per cent sulfur and 80.20 per cent insolubles while only 50 feet away and in the same ore body the sulfur content is reported to have run 14 to 25 per cent Microscopic examination of thin sections of the same sample showed that the pyrite occurred both in masses and in finely disseminated grains, the individual grains of the masses averaging 0 1 millimeter (0 0039 inch) in diameter, while the disseminated grains were uniformly small, many of them measuring less than 0 004 millimeter (0 00016 inch) in diameter

A Trolley Cable in Place of a Bridge

THE accompanying view in the lower right hand corner shows an aerial tramway employed in carrying men and material across the Tuolumne River at Hetch Hetchy, in California A heavy cable is stretched across the river, which supports the car, the latter being suspended below the cable on pulleys. These tramways make it unnecessary to travel great distances to the few bridges that cross the river

Trolley cables are employed in crossing the Hetch Hetchy River in the absence of bridges

The Noiseless Elevated

Philadelphia's Plans for Making Conversation Possible While the Trains Are Passing

By William A. McGarry

AN elevated railroad over which trains of ten all steel cars will roll at high speed with less disturbance of the surrounding atmosphere—and the eardrums of spectators—than that caused now by a single trolley car is nearing completion in Philadelphia So far not a wheel of a passenger car has turned over its tracks. But engineers of the Philadelphia Department of City Transit say this road will be the quietest elevated railway in the world

Instead of the usual ear-splitting rattle given off when a train passes, the noise of operation on this structure will be a deep rumble something akin to the roar of artillery at a considerable distance According to the engineers, it will be a noise of low pitch and of few vibrations compared to the familiar elevated train rattle, a noise that will cause far less interference with ordinary street conversation and that will be less of a nervous strain on the average citizen

This achievement, if it may be so called in advance of its completion, will be the result of perhaps a score of little changes in methods of construction, and two or three major mechanical developments, many of which have been put into practice singly elsewhere Some of these apply to the elevated structure and some to the cars being built for the line but all may be summed up by the statement that the object sought was rigidity at all times, solidly built bridge work with vibrations minimized, and rigid trains with no free play at the couplings for the usual jolting during starting and stopping

The line has been built by the city It runs from a junction with the present Market street elevated in a north and northeasterly direction, roughly paralleling the course of the Delaware River for a distance of eleven miles, and is virtually completed now with the exception of interior work on some of the stations, and the equipment Its operation has been delayed by failure of the city and the Philadelphia Rapid Transit Company to reach an agreement on a lease, with the result that the city is now building its own sub-stations, three in number, to distribute the current for operation, and is having built fifty steel cars containing many new features.

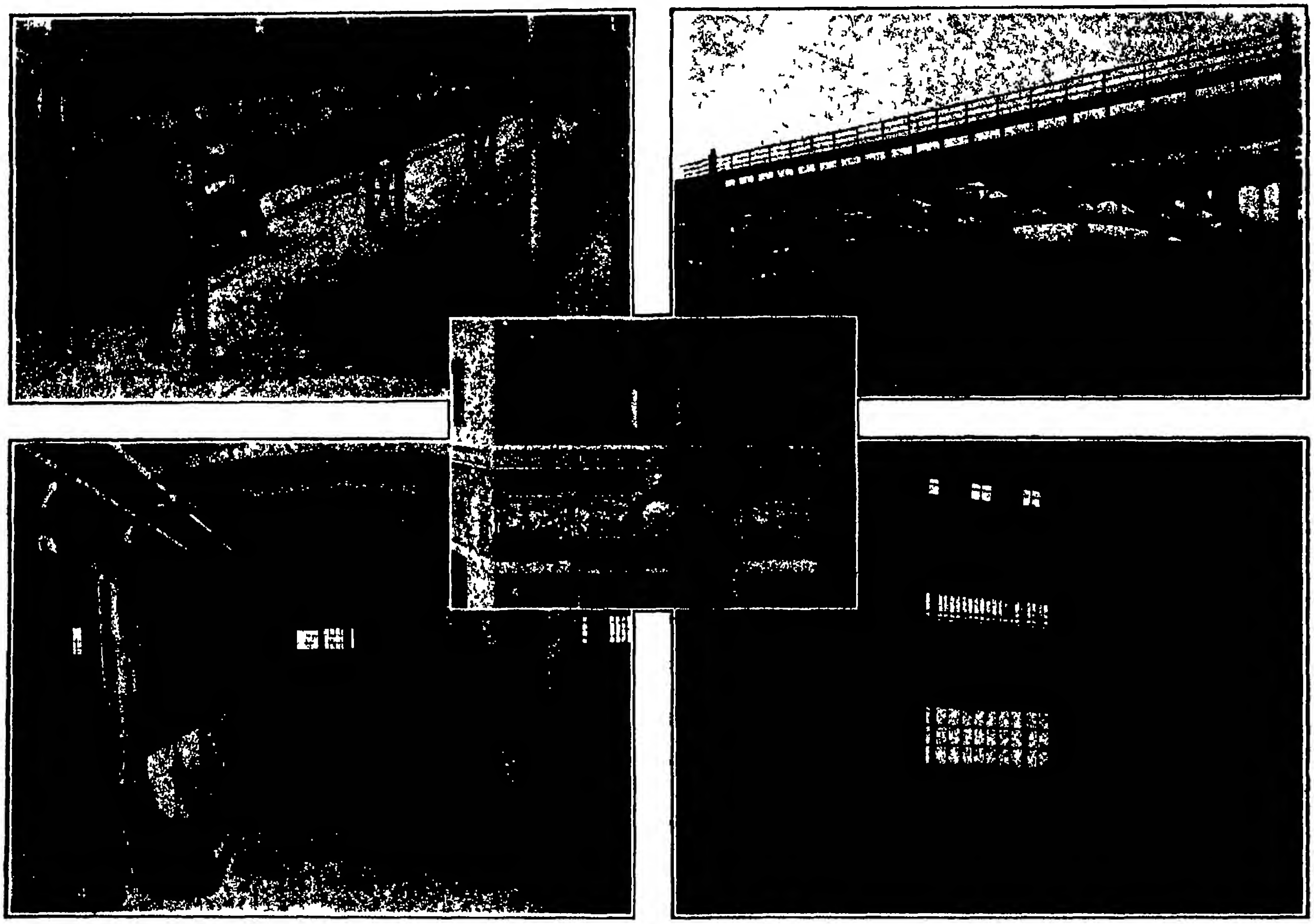
The structural features of the road are a development of those used in the old Market street elevated, completed in 1905, which is exceedingly quiet in operation compared to some of the New York and Boston elevated lines. That structure rests on H-beam uprights, with a flat steel and concrete deck, and a rock-ballasted roadway In the new line the channels of the H-beams are filled solidly with concrete, and the deck is made up of small concrete arches, as shown in the illustrations. These have been tested to a weight of thirty tons per square foot without showing any signs of failure.

Virtually the only noise-deadening feature of the Market street line is the rock ballast, but this, as has been said, makes a great improvement over the roads on which ties are laid directly on the steel. The concrete filling in the beam channels and the arch flooring are expected to cut the noise in half in the operation of the Frankford elevated, as the new line is known. The same effort for rigidity has been made throughout the construction The footwalk on both sides of the structure, for instance, is of concrete slabs instead of the usual boards.

A feature of this road which is of great importance is the fact that every station is built on private property taken over by the city, and not as an integral part of the elevated structure itself. This obviates the necessity of taking up sidewalk room with stairways. The building lines of these stations have been set well back in order to provide plenty of room for any future congestion Passengers enter a building resembling a bank, go up by easy stages and cross a bridge at platform level to reach the cars.

Short ties—a separate set for each rail—are used in the roadbed at the stations in order to facilitate the clearing away of the rubbish and litter thrown on the tracks by passengers waiting for trains. These ties are fastened directly to the concrete slabs, as the speed of trains at all stations will be so slight as to make the noise-deadening ballast unnecessary

One stretch of the elevated, about two miles in length, is rather novel. It is said to be the only cruciform type



1. The elevated structure south of Dyre St., showing single-column or T-bent type of structure on Frankford Ave., carrying two tracks. 2. The clear arch span of 112 feet over Lehigh Ave., showing the jack arch concrete floor 3. A detail of the ornamental work at the Allegheny Ave station 4 Interior view of partly finished car, showing longitudinal seat arrangement designed for maximum carrying capacity 5. Interior view of one of the stations, showing stairs from main floor to platform floor

Structure, cars and stations that contribute to the comparative noiselessness of Philadelphia's new elevated railroad

elevated in this country carrying two tracks, although there are several short stretches of single-pillar elevated lines supporting single tracks. This type of construction was used in a section of the city where the line traverses narrow streets, in order to avoid darkening the thoroughfare and the stores and dwellings. By way of anchorage the footings of columns, which rise from the center line of the street between double surface tracks, are spread out under these tracks, thus assuring extreme rigidity

A test car was loaded with seventy tons of steel rails and placed at different points along the line of the cruciform structure for the purpose of testing the strength of various members. No failure or excess stress was shown under the greatest concentration of load that will be possible in operation The most severe strains here, of course, occur with the load on only one track Throughout the line a protecting rail of steel is used instead of the wooden rail used on some lines. This is a regular track rail and not the familiar lighter type Engineers say that it will be impossible for a car to go off the structure after derailment, with this guard rail in place.

Unusual care has been given all along the line of the elevated to the question of preventing the darkening of streets. The entire under-surface, except over steam railroad lines, is painted gray, above the six foot line Columns are painted dark green to that height because splashing from vehicles would soon ruin the gray The effect of this is a considerable increase of light even on narrow streets. Surface drainage is so controlled that there will be little dripping from the sides of the elevated, the water being conducted direct to sewers.

The cars follow the lines of the new Brooklyn cars in some respects, but offer many improvements. They are limited by turns in the road to a length of 55 feet, and by conditions in the Market street subway—with which the new line will connect—to a width of eight feet ten inches. Seating capacity is 51 passengers, with total room for about 200 The silencing feature of the cars is the adoption of a new type of gear with which experiments have been made on the Long Island road for some time, with satisfactory results. It is something like a worm gear This is installed between the motor and the car wheels. In ordinary trolley car construction a straight-edge gear is used, and after a car of this type has been in use for some time it becomes noisy, due to gear rattling. Engineers of the transit department have made an exhaustive study of car noises and have determined that a great percentage of this noise comes from the gears in the operating machinery The new type of gear is set at an angle so that the grip at all times is by three teeth on each gear, instead of one, and regardless of the age or length of service of the car, rattling is impossible so long as the gears are sufficiently sound to make operation possible at all.

Elimination of noise is obtained also by the use of a patented coupling device which couples cars, current and air by simply running the cars together Each coupler is equipped with a cover plate which snaps shut over the electrical connections when the cars are separated. The couplers are so tight that a hose may be turned on them without getting any moisture to the electrical connections. Installations of these devices are a development made as a result of the study of patented automatic couplers in use experimentally elsewhere, particularly in New York

The only air coupling possible in an automatic device of this kind was a butt connection In ordinary construction there is a great deal of lateral and perpendicular play in the draft gear, and this adds in no small part to the general racket. It was necessary in the automatic coupler to have the butt connection absolutely tight, which means constantly rigid. And by attaining this the engineers attained also a train rigidity that is expected to prevent the usual jarring and jerking at starting. In other words, a train of eight or ten cars will start and stop as a single unit. The safety feature is the most important in automatic coupling, but the saving of time and labor is a considerable item

Safety features of these cars are the most advanced so far designed. A red light burns beside the motorman when all the doors are closed. Doors will be operated by separate air motors controlled electrically by multiple unit control, under a pressure of 360 pounds, which is expected to take care of winter conditions and dirt in the door track. Without a safety device this pressure, of course, would be dangerous. Accordingly the end of the door contains a spring, longitudinal, so arranged that a light touch on it makes an electrical contact that reverses the motion of the sliding door This device is so sensitive and so sure that according to the engineers, a passenger can stop the shutting of the door with his face without suffering the slightest injury Patrons of the New York subway will recognize it as fundamentally the same as the device recently installed to enable the Interborough trains to run with one guard, for two cars, stationed on alternate platforms.

After the door flies open its motion is again automatically reversed and it starts to close It will continue to run back and forth as long as there is an obstruction The builders realize that passengers will soon become aware of this and will take advantage of it to hold the door open for friends. Accordingly a key

The test house of metal lumber in Canton, O

is supplied to station men which will cause the door to close, suspending the operation of the safety spring, when inserted into a hole on the side of the car near the door. The New York subway cars might advantageously be equipped with something of the same sort, though the station man is usually able to solve the problem by a display of force

It is estimated that in the ordinary platform car with end and center doors the average walk of the passenger inside the car is one third the length of the vehicle In the new cars for this line the average walk will be onesixth the length of the car Doors are placed not only equidistant on the car, but also as regards the station There are no platforms and this permits the use of room that generally goes to waste The conductor is provided with a set of buttons. One controls all doors, and there are separate buttons for separate doors if their use in that way becomes necessary There is a step up by which the conductor may look over the heads of passengers. The placing of the doors is expected to bring about a great saving of time in loading and unloading cars, and also a better distribution of passengers with consequent elimination of congestion.

Air to the brakes is applied electrically for the whole length of the train, thus vastly decreasing the time necessary for a full stop. In event of a break in the current the same operation of the control applies the brakes in the usual method

Lumber of Steel

THAT metal lumber provides a most practicable home-building material is indicated by an exhibit recently completed in Canton, Ohio A two-story metal house was constructed to show that metal lumber construction has reached a perfected stage

From this house plans and drawings for homes of varying types, dimensions and costs will be evolved to meet the taste and purse of every home builder For each standard house every metal joist, stud and channel will be supplied of an exact size so that all parts fit quickly and easily Spikes and nails are replaced by bolts (⅜ inch and 7/16 inch) in the assembly of metal lumber

The general plan of construction in the house erected will be followed in all The framing of the outer walls is of four inch channel shapes on the inner and outer flanges of which are prongs, punched for the attachment of metal lath Partitions are erected of two or four inch studs, on both sides of which metal lath is affixed. Plaster is then applied as in homes of wood construction. The floors are constructed by using metal joists, spaced by two feet. Strips are nailed to these joists and wood or composition floors may be installed as in any conventional construction building

Metal lath goes quickly into place on the bottoms of these joists to provide ceilings. Metal lumber rafters support the roof to which nailing strips are attached. Any form of roofing desired may be applied Wood grounds are applied for the installation of windows, door frames, baseboards, picture molding, etc In the finished house no metal can be seen, inside or out

An exterior finish of stucco is used It is pointed out that in a building of such firm framework this stucco will be permanently free from cracks, sometimes caused by settling or "weaving" Plaster and interior finishes will also be preserved

The steel structure is imbedded in the foundations at all points and is thus anchored securely The foundations may be of any standard type Fire risk is reduced to a minimum The building is far more fireresistive than a brick house with wood partitions. Fire can not get in from the outside and is confined to any room in which the blaze originates

Diminished Flax Acreage in Ireland

FOLLOWING a recent official survey of the acreage in Ireland under flax during the present season, it is announced that the growing area is 40 000 acres, as compared with 127 000 acres last year reports the American consulate at Belfast The reason for the decreased acreage this year is to be found in the reaction of farmers from the artificial stimulus afforded by a Government bounty, now withdrawn, and by the contribution by the linen manufacturers themselves of the sum of £630 000 to the flax growers as an additional bonus during 1919 to promote the growth of flax at a time when linen products were commanding phenomenal prices. Coincident withdrawal of both these inducements for a supernormal crop has resulted in a subnormal one—Irish farmers apparently possessing their fair share of human nature

Manufacturers are unable to forecast the result of this flax shortage upon the linen market in the near future. There is much flax, they assert, in the hands of farmers, unsold, which is being retained in the hope of higher prices. They claim that, in view of the world-wide depression in business, they are unable to sell linens at remunerative prices or to create a demand for flax at such a price as will induce the farmer to sow the normal acreage Everything depends upon a return of business to its usual volume Should this condition arise suddenly, the flax shortage would become acute, as it is claimed that the quantity held in reserve by the farmers would not supply the Belfast mills for a period longer than three months were they all to resume work at full capacity

A Novel Sprinkler for Golf Greens

EVER since the artificial watering of golf greens has been resorted to as a dependable method of maintaining the turf and grass in a vigorous, growing condition during periods of droughty weather, difficulties have been experienced in shifting the sprinklers and hose about so as not to injure the green with foot tracks or other objectionable marks. At the Wawonowin Golf Club, Ishpeming, Michigan, this problem has been solved successfully by the perfection of a home made sprinkler made of corrugated carbide cans which are so arranged that they can be shifted about the green even when it is soaked with water without damaging the grass in any way. Any large, round can could be used instead of carbide cans, the outstanding feature of importance about these containers is that they are made with corrugated surfaces which cannot be dented easily.

Wooden ends are placed in the carbide cans and each of these covers is perforated in the center so that they will carry a ¾ inch pipe. The cans are spaced at intervals in such a manner that they really operate as rollers for the pipe, which in turn is connected to the water hydrants and hose. A simple sprinkler which will not get out of order or clog is placed at each end of a length of pipe. The distance between the sprinklers is determined by the water pressure in the locality where the novel sprinkler is used. At the country club where this plan was originated the sprinklers are placed 26 feet apart so that they water a green zone 52 feet wide. By the use of hose 75 feet long, greens which are not over 150 feet wide can be sprinkled satisfactorily from faucets on each side. The sprinkling is started at one end of the green and as the various zones in turn are watered thoroughly, the sprinkling apparatus can be pulled gently toward the other end of the green without any damage to the turf and without the necessity of the attendants stepping over the saturated greensward. The extra carbide can nearest where the hose is attached to the pipe has to be removed after a revolution or two, but by that time the can has reached dry ground. The other cans serving as idlers support the line of hose.

Any competent workman can construct one of these novel green sprinkling outfits in about three hours. This home made device is superior to all the commercial revolving types of sprinklers, which begin to wear out immediately after they make their first revolution and soon produce uneven distribution of the water. The Michigan sprinkler is cheap, durable and efficient, it is light in weight and can be readily carried in one hand. The sprinklers are so cheap that the best plan is to provide enough for each green on the golf course. They are particularly valuable for watering greens at night during hot, dry, summer weather, when it is almost impossible for workmen to operate the ordinary run of green sprinklers in the dark without damaging the greens in one way or another.—By *G H Dacy*

Large carbide cans form the basis of this interesting system of lawn sprinklers, which is said not to injure the grass in any way

The Grunewald Automobile Race-Course

THE necessity of a special automobile road in the neighborhood of Berlin had long before the war made itself felt in an ever increasing degree. On the one hand, the pedestrian and vehicular traffic was more and more inconvenienced by the rapidly growing motor-car traffic, and on the other, there was an increasing demand for special race-courses suitable for efficiency contests, such as could not always be held on the roads serving general traffic purposes.

Plans of building a special motor-car road were therefore suggested as far back as in 1906, in connection with the Taunus races, but not until the last years preceding the world war could these be brought to a happy end. A special company was founded with the cooperation of the municipal corporations of Greater Berlin, which for a period of 30 years rented a strip of land 6 miles long and about 45 yards in average width, extending from Witzleben Station, at the entrance to the Grunewald forest, to Wannsee Lake.

The aim of the undertaking was to provide a motor-car road embodying the best practice of road building both in European countries and the United States and taking into account the experience gained in connection with international automobile contests. While no comparative data on the roads built in this country are available at the time of writing, the constructors claim for the new race-course the distinction of being the most remarkable in Europe.

Berlin's new automobile parkway, with one of the feeder roads leading into it (from the left in this view)

From a constructive point of view, the road presents a number of interesting features. It is made up of two parallel straight courses, connected together at the north and south ends, respectively, by huge curves, its total length being 12 miles. Whereas in the case of motor-car roads previously built, the top line of the curved surface runs in the middle, the new road is so designed that cars entering it on the right will keep their wheels at constant height, thus affording the double advantage of uniform wear and remarkable ease of control, even at maximum speeds. The stone layer about 25 cms. in thickness constituting the bedding of the road is made up of a continuous row of coping stones 25 cms. high, joined to one another and which, being let down to the level of the road, constitute on both sides an invisible concrete wall. The road traverses practically level ground and, accordingly, can readily be inspected over a considerable length, which, of course, greatly increases the safety of traffic.

Concrete viaducts (20 altogether) have been provided at each crossroad, thus avoiding any level crossing. The two rectilinear courses run close to one another, inasmuch as each of them is traversed in one direction only, any risk of collision of cars traveling in opposite directions is avoided. The width of the road (26½ feet) is so calculated as to allow four cars at the same time to overtake one another. Parallel to the road there are grass strips running outward and inward, to which any damaged cars can be removed in safety. The special configuration of the road section causes the driver automatically to keep to the right. The design of the tarred upper layer insures imperviousness to water and perfect freedom from dust.

The construction of the road was, in 1914, nearing completion, so that its inauguration could be anticipated for the fall of that year. However, the world war and its immediate after-effects, from 1914 to 1920, temporarily stopped the work. This long period of enforced idleness has, by the way, done the road no material harm. On the contrary, the race-course has had time to settle and will not undergo any further deformation. Moreover, a few months have been sufficient to rid the road of its weeds, and to renew the gravel layer. The tarring is but a matter of a few days, so that the road was ready for training for the automobile races in September.

At the very last moment the company decided on enlarging the Southern curve to a width of about 83 feet and a superelevation of 1.7, and a similar enlargement of the northern curve is being contemplated for the near future. The two curves are 876 feet and 940 feet, respectively, in diameter.—By *Dr Alfred Gradenwitz.*

The southern curve, on which the road is broadened to a width of about 83 feet

Bombing and Bombing Sights

How Aiming from the Unstable Platform of an Airplane Is Made Possible

By Dr. E. J. Loring, Army Ordnance Engineer

NAVIGATION of the air was scarcely a proven possibility before consideration was given to its military uses. Even the earliest airplane meets had their "bombing" contests of dropping bags of flour or oranges upon targets outlined on the ground. Small wonder, then, that with the advent of the war the inventive resources of the nations were turned to the new locomotion and to the development of its possibilities. The first uses were naturally for reconnaissance and fire control, but the capabilities for offensive use were clearly evident, and there followed the dropping of steel darts on assemblages of troops and animals, of incendiary grenades on grain fields, and before long the Zeppelin bombing raids. The development of bombs and airplanes progressed together—larger bombs and airplanes of greater lifting capacity and greater cruising radius to carry them—until at the close of the war each principal nation had built or projected a bomb of 1000 pounds weight or more of which about half the entire weight was high explosive. Other types of bombs were also developed fragmentation bombs to scatter the sharp fragments of the bursting case among personnel, incendiary bombs to start fires from a shower of burning material or from a mass of oil with a high temperature core, bombs with smoke-producing liquids, bombs to give high-power illumination, to pierce armor plate, and for submarine attack.

Of all these types, the greatest development was in the demolition bomb with its great mass of high explosive, reaching the greatest weight contained in any projectile, and the enormous power of such bombs when favorably placed has been shown lately in the sinking of the German ships and the ex-U.S.S. "Alabama."

It is not generally contended that these results are truly indicative of the results to be expected in actual warfare today, the tests were rather to show the results of which the bombs are capable when favorably placed, and the question of placing them is another matter. For it is only the hits—direct, or alongside of ships—that actually count, all others are without effect except on morale, and unless some desired point is within the destructive area of the bomb as it hits, the bomb and all the time, energy and expense of its production and transportation and the risks to airplane and personnel have been ineffective and wasted.

The efficient functioning of the bomb and its fuses is thus a distinct problem from that of efficiently placing the bomb, and with the increasing power of the anti-aircraft defense, driving the airplane to higher altitudes, the problem of placing the bomb becomes increasingly difficult.

At the close of the world war the usual altitudes were 15,000 to 17,000 feet for day bombing, 8000 for night, 4000 for naval and 2000 to 1000 feet for submarines. While at the lower altitudes judgment and experience might be sufficient, at the higher altitudes definite guides for aiming became a necessity.

From the day-bombing altitude of 15,000 feet the head of a common pin held at arm's length covers a circle of about 50 feet diameter on the ground, a circle that will enclose the ordinary farmhouse, and is about the size of the crater of a 600-pound bomb, and the airplane traverses this diameter in from one-fifth to three-fifths of a second. With a delay fuse, the size of the crater is a fair measure of the destructive effect of a demolition bomb, and with a fuse giving one-half second delay or more, the diameter in soft soil is about

$$4\sqrt[3]{\text{weight of bomb}} \quad \text{or} \quad 5\sqrt[3]{\text{weight of explosive}}$$

The actual destructive area is somewhat greater, for the 2000-pound bomb the crater is about 50 feet across, but dropped in woods with instantaneous fuse the destruction covers 200 feet radius. Figure 1 shows the apparent size of the destructive areas for several sizes of bombs at the usual altitudes, if viewed from the height of a table, and represents the relative area within which the bomb must be dropped to have effect. Another view shows the effect of a direct hit on a rail road track with a 112 pound bomb, and it will be seen that a hit twenty feet to either side would have done far less damage.

In order to place the bomb within this limited area the flight of the airplane must be directed in a certain definite relation to it, and the bomb released at the precise instant on that flight, with a leeway of not over one-fifth of a second. At the instant of release the bomb has the motion of the airplane, that is, the actual motion in relation to the ground, and the control of the direction of this motion for a point one to three thousand feet ahead requires more than a simple observation. Further, the bomber usually has no direct control of the direction of the airplane, and can guide it only through the pilot, with whom he may communicate by signal or by reins on the pilot's elbows, and almost every airplane, whether bombing or otherwise, is "blind," so that the pilot, from his seat, is unable to see the ground at the bombing angle. The bomber too, unless located in the prow has only a very limited view of the target, and at low altitudes can see it only a very little time before the bomb must be released, during which time he must recognize the target, and possibly correct the direction of the airplane and set his sights.

The bomb when released from the airplane continues in motion with it, but is immediately subject to the action of gravity, acting vertically downward, and the bomb takes up a downward motion in addition to the forward motion which it already has. The effect to the bomber is as though he were fixed in space and shooting at the rapidly moving target with a low-power gun that is fixed vertically, he can not point his gun, but can only await the proper moment to fire it. He knows that it is fixed on the vertical, but he can neither see the gun nor see the vertical to recognize it, for the sense of vertical is nearly lost in an airplane, and is sensible only from the perspective of the earth's surface. No pendulum or spirit level can give it, but will only indicate the apparent vertical which departs from the true vertical on every bump, pitch, side-slip or turn of the airplane. Whether on foot, bicycle, automobile, ship or airplane, no course is ever laid truly on a straight line, but at best is a succession of slightly curving paths on which an error of direction is accumulated until recognized, and then corrected. These curves may be slight, but lateral forces arise instantly and cause deviations of any pendulum or similar device.

A deviation of one degree is an error of 175 feet on the ground at 10,000 feet, and is a complete miss.

DEVIATION OF A PENDULUM FROM THE VERTICAL ON A TURN

Deviation degrees	Speed of airplane 100 ft/sec		Speed of airplane 150 ft/sec	
	Radius feet	Time for complete turn	Radius feet	Time for complete turn
1	17820	18 min. 40 sec	40100	28 min. 0 sec.
2	8910	9 " 20	20400	14 " 15
3	5940	6 " 18	13600	8 " 30 "
5	3556	3 " 43 "	8000	5 " 35 "
7	2582	2 " 39	5700	4 " 0 "
10	1765	1 " 51	3945	2 " 45
20	855	51	1924	1 " 21 "
30	539	34	1213	51

Note: Radius feet $= 0.311 \dfrac{V^2}{\tan \theta}$

Seconds on turn $= 1.955 \dfrac{V}{\tan \theta}$

V = ft/sec θ = angle

Thus the bomber, shooting from his unstable platform at the rapidly moving target unable to direct his shot except in part by directing the airplane itself through the pilot, can not by his own senses or by any ordinary apparatus determine precisely the forward path of the bomb or the vertical from which to determine its range.

To show something of this difficulty of sighting on the vertical even under the best conditions, place the sheet with Figure 1 on the floor, select any particular circle, and try to drop a pencil into it from the level of your eyes or better, place it a few inches from the edge of a platform, 5 feet high and try to roll a marble off the platform to hit within the selected circle while someone moves the figure.

With this great and fundamental difficulty of getting the vertical many efforts have been made to find other means of finding or holding the vertical. So far there has been but one true vertical observed from an airplane, its own reflection in still water below it, as found by Major F. C. Brown, and on this phenomenon the Ordnance Department of the Army has based its trajectory tests, photographing the falling bomb against the reflection of the airplane with a moving picture camera. An observation method is by the use of two vertical mirrors at about 45 degrees to the line of sight to right and left, when the horizon shows at the same height in both mirrors the intersection of their planes is a vertical line. For service use, however the development is toward the use of a gyroscope, to give a reference line or to actually hold the bomb sight in position. Such a gyroscope is very sensitive. It may carry the sighting apparatus directly upon it or may hold the apparatus parallel to itself by the action of relay mechanism, by which means the apparatus may be handled without disturbing the gyro. Figure 3 shows a stabilizer of the first type, with the attached sight. This gyro has a three-phase electric motor taking current from a special generator, driven by an air fan in the slip-stream of the propeller.

The Bomb Trajectory. A body dropped in the car of a railroad train in motion falls to the floor at the same point it would strike if the car were at rest, and if dropped outside the car it would fall on a vertical line as seen from the car, except for the effects of the resistance of the air. In the same manner, the horizontal momentum given the bomb while on the airplane carries the bomb forward during its fall and determines the

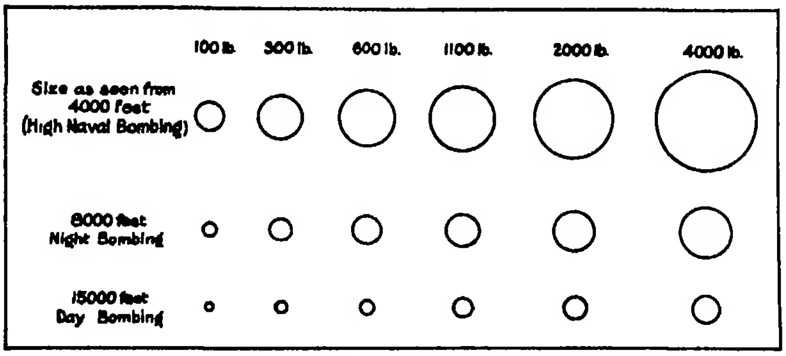


Fig. 1. This diagram viewed from the height of a table, represents the area of destruction for demolition bombs (50% explosive) of the respective weights, as seen from the altitudes given

Fig. 2. Damage to railroad tracks by a direct hit of a 112-pound demolition bomb

direction of its path, and if there were no resistance from the air the bomb would always be vertically under the airplane, but because of this air resistance the bomb lags behind in its path both vertically and horizontally so that unless otherwise directed by the vanes in a manner which will be referred to later the bomb is always behind the vertical from the airplane this distance at the ground being called the "trail."

From the airplane it is the ground that seems to move and the bomber is endeavoring to shoot against a target moving with the speed of the airplane. The bomb at its release seems to fall down an inclined curved line at the rear to the ground. This is the one and only direction in which the bomber may shoot and his only control in range is to release at such an instant that the bomb falling down this inclined curved line reaches the ground in precisely the same time that the target takes to reach this line so that bomb and target meet. This is much the same as shooting ahead of a flying bird to bring it down but in this case there is no choice of angle or point at which the hit is to be made as is had by pointing the gun, the hit must be at the trail, and the bomb must be released ahead so that the target reaches that point at the same instant as the bomb.

These conditions are shown in Figure 4 a bomb released at O falls along the curved path OHA striking the ground at A the airplane in the meantime moving to B. The bomb as seen from the airplane falls down the curved path BA to the point of hit seen at the angle LBA behind the vertical BL. If there were no air resistance the bomb would at all times be vertically under the airplane as at F and G and would fall along the dotted curved path OGDC a parabola, reaching the ground at D. The angle from the point of release to the point of hit from which the latter would be predicted, is given then by the relation

$$\text{tangent of angle of sight} = \frac{\text{travel of plane during fall less trail}}{\text{altitude of plane}} = \frac{OB - AL}{BL}$$

Knowing the vertical, the speed of the plane in relation to the ground the altitude, and the characteristics of the bomb lines or points may be set up in an apparatus in the airplane to form triangles with sides parallel to the lines of the figure, and thus predict or indicate at each instant that point on the ground that would be hit by a bomb released at that instant. The sides of such triangles may be proportioned to distances or to velocities, for example, *am* may represent the mean velocity of fall and *ob* the ground speed of the airplane, or *am* may represent the altitude and *ob* the travel of the plane for the time the bomb is in the air and it is on such a basis that all bomb sights are constructed, although with many modifications.

Most bomb sights at present in use have been intended for use only in the plane of the wind—that is, up or down wind, but this restriction is a very serious one, particularly where there is an effective anti aircraft defence, as the directions of attack are then known in advance, and several bomb sights have been devised to permit of use in any direction to the wind. The action in a cross wind is readily understood if we consider that the effect of the wind, as seen from the airplane, is to blow the ground away up wind. In Figure 6, a view in plan the airplane is at O flying with its axis directed along OA when the bomb is released, and during the fall of the bomb the wind has moved the distance and direction AA', carrying with it the entire plane in the air containing the airplane and bomb to the position O' A' at the instant of hit. The point of hit is still in the plane of the axis of the airplane, as with no wind, since the bomb has received only the same lateral displacement as the airplane itself, but this point is no longer on the projecting path of the airplane OL' but to one side. This correction may be made in the construction of the bombsight by setting the trail correction always in the axis of the airplane while deviating the line or plane of sight to the side.

In every bombsight it is necessary to establish a line of sight—the range sight—from which the target will move to the trail position in the time of fall of the bomb. To establish this it is necessary to have some measure of the ground speed, and this has been done by timing, either directly over a measured distance, or indirectly by coincidence methods, by synchronizing, in which a part of the apparatus is caused to move at the same apparent speed as that of the ground, from data of air speed and wind speed and observation of drift, and by compounding the apparent motion of the ground with a known lateral motion. Figure 7 is known as the "equidistant" method, there are three points an equal distance apart, the rear point being on the trail sight, there is a reversing stop watch, having an indicator which may be at the time of fall of the bomb, indicated by an altitude scale. The watch is started in the normal direction when the target passes the first line of sight, reversed when it passes the second, and the bomb is released when the hand returns to the position of the indicator, the hand, continuing, will reach the starting point when the bomb reaches the ground and the target reaches the line of the trail sight. The principles of Figure 8 have been used a great deal. There are two scales, one for altitude and one for time, corresponding for the particular bomb in use. The time is taken for any object to pass from the altitude point to the trail, and a point is set at this time on the time scale giving the range sight, indicating the point on the ground that the bomb will hit, so long as the airplane continues to fly at that speed and direction.

The values for the trail for a given bomb are obtained with great difficulty through long and tedious tests and computations. They depend chiefly on the factors of altitude, air speed, and the shape, weight and resistance of the bomb at various speeds, and the variation of air density. Most sights are arranged for only one set of conditions, but it has been found possible to arrange apparatus to take account of all factors for different bombs with only a slight maximum error.

The bomb sight indicates to the bomber the point on the ground which would be hit by a bomb released at that instant, taking consideration of the ground speed, wind speed and direction, air speed, altitude, and the bomb's characteristics, or with considerable of these factors, it may indicate the proper moment of release, or perform that function automatically. The complete sighting apparatus is required also to determine the speed and direction of the airplane and of the wind in relation to the ground, and to show the proper direction of the axis of the airplane to reach a given target and to communicate this direction to the pilot.

The bomb is an elongated body provided with fins or vanes at the rear to direct it on its path. But the path is curving, as shown in Figure

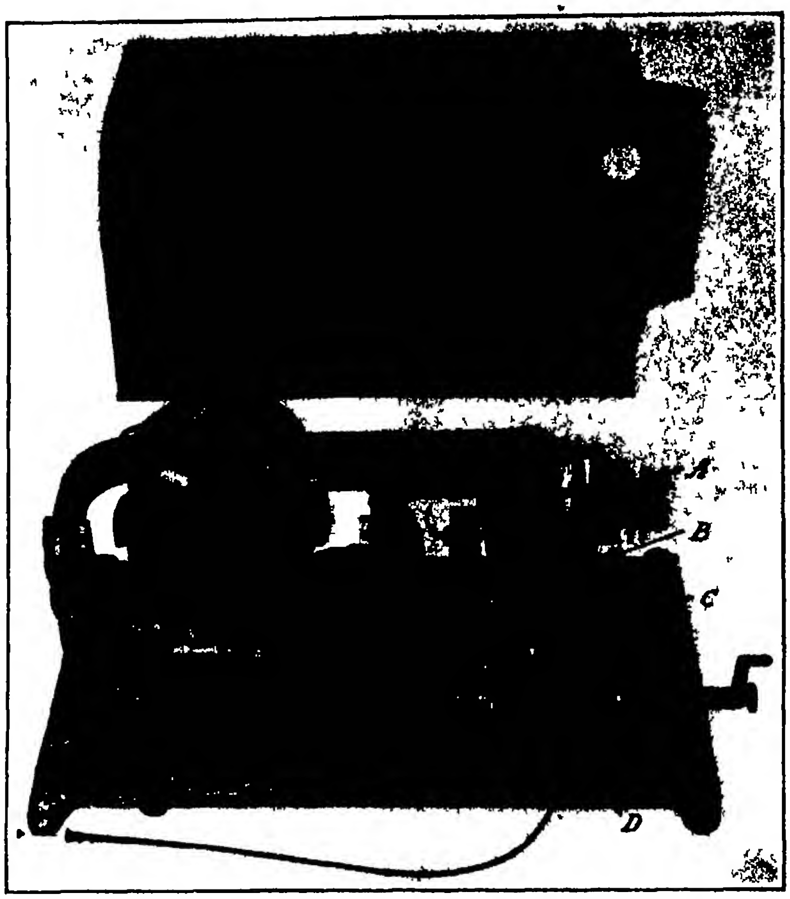


Fig. 3. Gyro stabilizer and attached bomb sight. Cross sections hold the bomb sight parallel to the gyro axis, and devices of the gyro control balance weights that tend to hold the gyro axis vertical. A. Timing and trail knob. B. Altitude knob. C. Collimator, directed on line of sight. D. Glass window in base

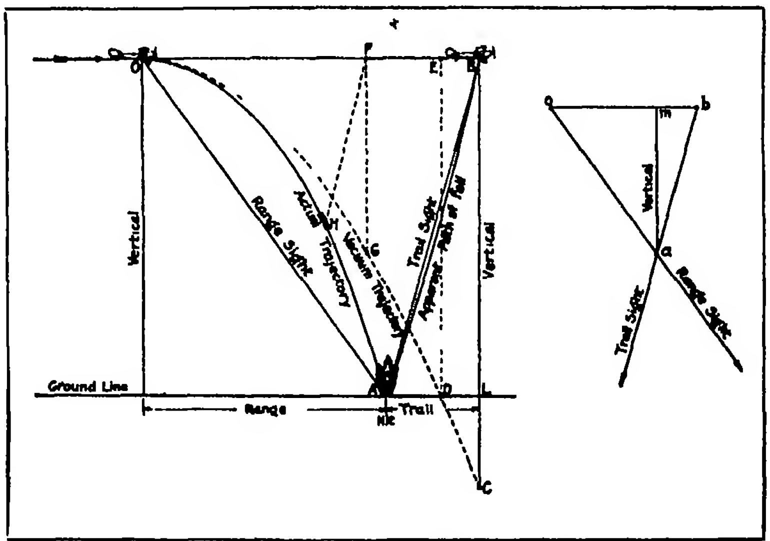


Fig. 4. By the time bomb, released at O, strikes the earth at A, the airplane has moved forward to B. Air resistance retards forward movement of bomb

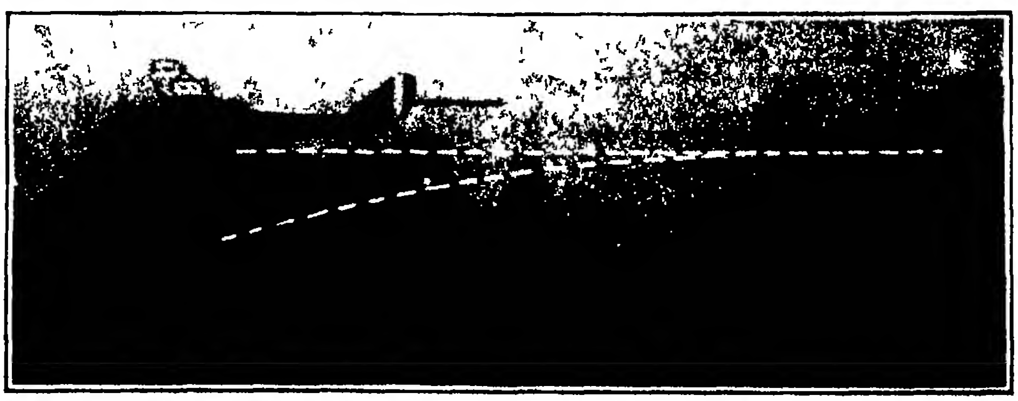


Fig. 5. Bomb dropped from airplane, showing true flight. Note how the bomb follows the airplane

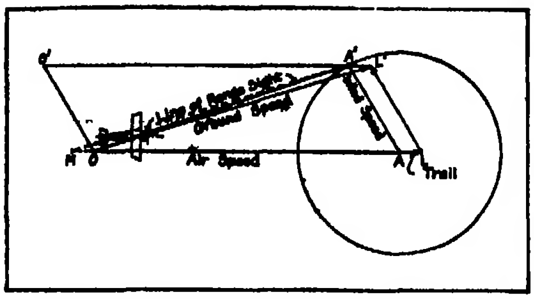


Fig. 6. Showing effect of a cross wind on the path of an airplane

4, and if the bomb is not properly proportioned or the vanes have been damaged, the bomb may not turn sufficiently and may move at an angle with its path. If this angle becomes great, the forces on the vanes may change the path, if nosing up, or hanging back on the turn, as at A, Figure 10, the bomb is forced forward or "skids" at the expense of its downward velocity, if nosing down, as at B, it may be forced down in a more nearly vertical path at increased speed, transforming its forward into downward motion, so that it may reach the ground in even less time than the theoretical bomb of no air resistance Figure 5 shows a bomb properly directed on its path Figure 11 shows three bombs, one flying true and two nosing up Figure 9 shows the path of two bombs, supposed to be similar in every way, one of which fell true and the other wobbled or possibly even cartwheeled. It is impossible to predict these variations, but fortunately they are much reduced with increase of size Accurate bombing not only requires that a bomb take a certain path, but that it always take the same path, so that its point of hit may be predicted.

It will be seen that it is by no means a simple matter to direct an airplane and release a bomb under trying conditions in a manner to obtain a hit It requires good training and team work in pilot and bomber, steady nerves, quick reaction, a special class of personnel, sighting apparatus of a special nature, steady airplanes, and a careful proportioning of the bombs for steady flight But good bombing will place a given weight of bombs against a target with less loss of bombs, of airplanes and of personnel.

Probable Limits of Electric Generators and Superpower Plants for Germany

WRITING in *Zeitschrift des Vereines deutscher Ingenieure* for August 27, 1921, and abstracted in *Mechanical Engineering* for November, Prof W Reichel discusses the problem of the most economical and the largest commercially possible sizes of electric generators for central stations. The economy of large units is generally recognized and an interesting discussion is devoted to the question as to the largest possible sizes.

The most advisable speeds for various sizes are given as 3000 r p m for generators up to 25,000 kva, 1500 r p.m for generators up to 40,000 kva, and 1000 r p m. for generators up to 60,000 kva As examples of large generators two units are cited of 60,000 kva. at 1000 r p.m. installed during the war in Germany The diameter of the rotor is 2.25 meters, so that the peripheral velocity at 1000 r.p.m. is about 118 meters per second. Such large dimensions required a very powerfully built axle and also a design in which the critical speed was higher than the operating speed As a matter of fact, the axle weighs 86 metric tons. The teeth are provided with ventilating orifices through which air for cooling the rotor is driven

The author distinctly states, however, that 60,000 kva. is by no means the limit of size for such generators, and theoretically it is by no means impossible to go considerably beyond that In fact, he says that it has been established by calculation that generators may be built in sizes up to 160,000 kva and the most serious obstacle in the way of accomplishing such constructions lies in the difficulty of the transportation of such huge machines by railroad, necessitating their assembling and, in particular winding on the spot of installation, a process not always attractive

The use of giant machines of 160 000 kva at 1000 r p m is suggested in a central station with six units, one being a standby Such a plant would have a normal load of 400 000 kw and a peak load of 500,000 kw, with a total output per year of say 2 000,000 kw hr Five such central stations would have been sufficient to satisfy the entire demand for electric power in Germany For steam turbines driving these generators are suggested double units with steam admission in the middle 16 to 17 atmos pressure at the turbine inlet and 20 atmos. gage pressure on the boiler with a steam temperature of 350 degrees Centigrade at the turbine inlet valve

In view of the great consumption of fuel and water of condensation it is obvious that economically such big plants should be located only near a large coal supply and also near a large river Assuming that coal would be delivered 300 days in the year, this would mean that 7500 tons per day would have to be received into the plant and be distributed either to the boiler rooms or to the bunkers.

The general conclusion to which the author comes is that at present the limit to the size of electrical generators is set mainly by the demand for power

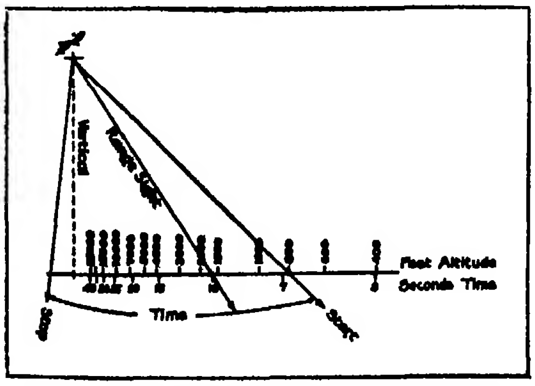


Fig. 8. Method of sighting, involving use of an altitude and a time scale

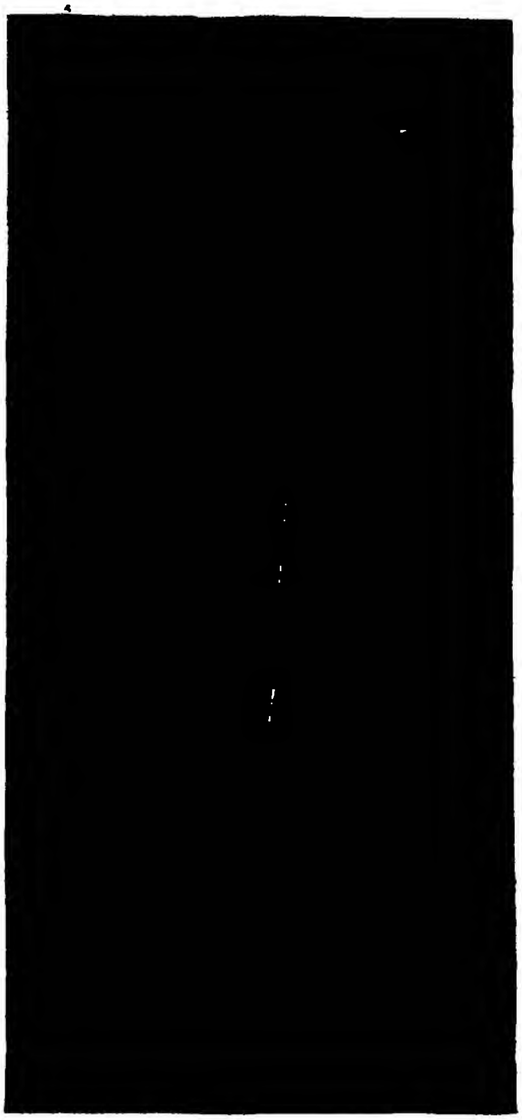


Fig. 9. Night photograph by Dr. A. W. Duff, using a storage battery in the bomb and an electric light on the tail. Note that the bomb that is wobbling—probably "cartwheeling"—loses its forward velocity more quickly, and finally falls in a nearly vertical path. Full breaks in the lines indicate seconds. The bright points are stars

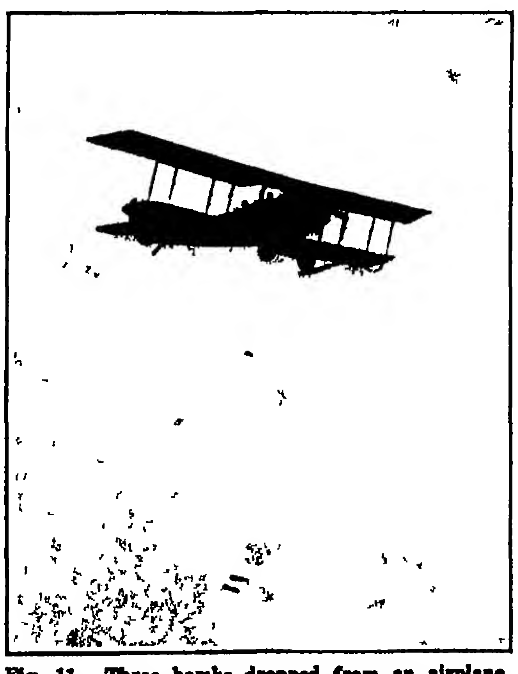


Fig. 11. Three bombs dropped from an airplane. Note the true trajectory of the upper bomb and the "nosing up" of the two lower bombs. Accurate bombing not only requires that a bomb take a certain path, but that it always takes the same path

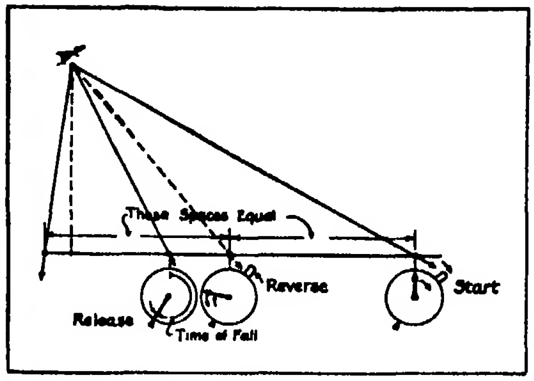


Fig. 7 Diagram illustrating the "equidistant method" of sighting

What Is Gray?

A NEW publication, Scientific Paper of the Bureau of Standards, No 417, entitled "The Spectral Distribution of Energy Required to Evoke the Gray Sensation" has just been announced. The chief significance of this paper lies in the development and testing of an experimental method for determining an objective physical standard of "white light"

Experimental results are given from four observers. The average results of these observers indicate that "white light may be represented (1) Theoretically, by the light from a Planckian radiator at a temperature of 5200 degrees absolute, (2) practically, to a fair approximation, by average noon sunlight at Washington It is however, emphasized that the final establishment of such a standard should be based on a more extensive statistical investigation

An appendix to the paper sets forth the desirability of an extensive statistical determination and correlation of the characteristics of color vision This publication is now ready for distribution, and any one interested may obtain a copy by addressing a request to the Bureau of Standards until the free stock is exhausted.

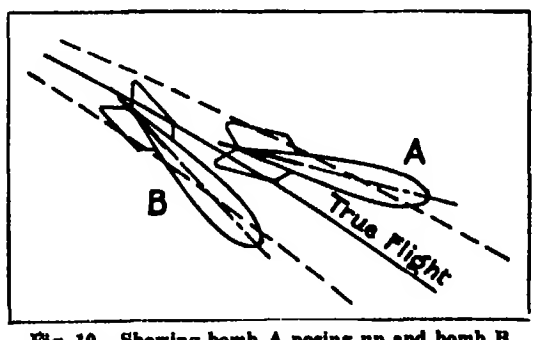


Fig. 10. Showing bomb A nosing up and bomb B nosing down

Ichthyosaurus with young, from photograph in the American Museum of Natural History

How Did the Ichthyosaurus Live?

NO other prehistoric creature now extinct is receiving as much consideration to-day as the Ichthyosaurus. The popularity of this sea reptile is chiefly based on the fact that numerous well preserved fossils are constantly being found. In certain sections of the slate-quarries in Holzminden and other parts of Wurttemberg they are found in such large numbers that one can almost be procured as desired. It is for this reason that Germany's geologic collections comprise such complete and interesting specimens of a now extinct past.

In view of the wealth of fossil material available for investigation and comparison, the scientist was enabled to study every detail of the bodily structure of this sea monster. The scientist was also enabled to determine to a large extent its habits of life by means of a comparative study of existing creatures, whose bodily structure resembles that of the Ichthyosaurus.

The Ichthyosaurus appeared chiefly in the Jurassic and Cretaceous formations in Europe as well as in the Upper Jurassic strata of America to Greenland in the North and likewise in the Upper Triassic formations of Europe. Individuals 10 meters long were then a common occurrence, lived exclusively in the sea, and consequently might be considered to have adapted themselves to this life to a very high degree. Undoubtedly they were descendants of some land monsters, although their bodily structure shows they were utterly incapable of moving about on land but spent their lives exclusively swimming about in the water. In addition to their bodily characteristics, which show adaptation to an aquatic existence to a high degree, their method of reproduction is evidence of this fact. Sufficient proof exists that they were born alive. A total of 14 bodies of Ichthyosaurus were found with young ones in their bodies. Considering the condition of the young ones in a number of these specimens the process of birth became problematical in view of the fact that many of these young ones were facing each other. Both Owen and Quenstedt expressed the belief that the Ichthyosaurus frequently ate their young ones. Branca deserves the credit of having definitely established the truth of this assertion by X-raying a Berlin specimen.

The Ichthyosaurus possessed a long tailed head which was joined to the spindle-formed torso practically without a neck, a fact which enabled the monster to skim through the water with practically no resistance. Undoubtedly, through bodily structure and limbs, they must have been the best swimmers among the sea-animals of that time. They possessed very short limbs of a finny structure. The hind rudder-organs showed weak development since locomotion was obtained by means of the two lobulated tail fins, acting in conjunction with a rather high back fin as keel.

In the structure of the skeleton of the limbs we find proof of a striking increase in the number of phalanges, which enlargement of the fins was no doubt the result of a splitting of three or five fingers as evidenced on all Triassic formations. The gills are considerably more pointed, and are equipped with a set of teeth, set in a common groove, the possession and formation of which give proof of the dangerous predatory instinct of these monsters. Large circular bony plates protected its eyes against the water pressure at great depths, for the Ichthyosaurus, like the whale, was an unusually good diver. They lived chiefly on cuttle-fish (Belemnites) and fish. In the upper Jurassic formations we find forms equipped with considerably fewer teeth. This reduction in the number of teeth is unquestionably due to the increasing numbers of soft-shelled cuttle-fish which developed at that time and which formed their main diet.

A peculiar characteristic of one completely fossilized specimen is a semicircular throat-sack, whose function has not yet been determined. Perhaps it served a purpose similar to that of the human larynx, or of a box which had some connection with its absorption of food.

The skin of the Ichthyosaurus was completely naked, being an adaptation to its aquatic existence and its swift movements, and in order to overcome the resistance offered by the water. Nevertheless, there are traces of armored limbs (Panzerresten) to be found on the front and hind fins, which give proof of the fact that its land predecessors were armored.

In the black Lias strata of Swabia several specimens with well-preserved skins were found, on which the outlines of the present tail-fins are completely retained. These fins are vertical in position, that is, they are joined symmetrically even with the body. The vertebral column shows a pronounced curvature in the region of the tail, which is indicative of the function of the tail-fins as organs of locomotion.

In their outer appearance the Ichthyosauri remind one very much of the Delphine mammals. This correspondence can only be accounted for by necessary adaptation to a similar mode of living. Among other characteristics its simple vertebral head bespeaks its monstrous nature. Bony ventral ribs covering its thoracic cavity, unquestionably enabled it to take in large quantities of air in diving into the depths, for one must assume that breathing took place through the aid of the lungs.

The large numbers of fossilized specimens found prove that these animals led a gregarious existence, and that, like the whales, they moved about in large schools. Whether or not they are to be considered as having been the sole inhabitants of the high seas, Solenhofen's discoveries prove that they even ventured into shallow bays.

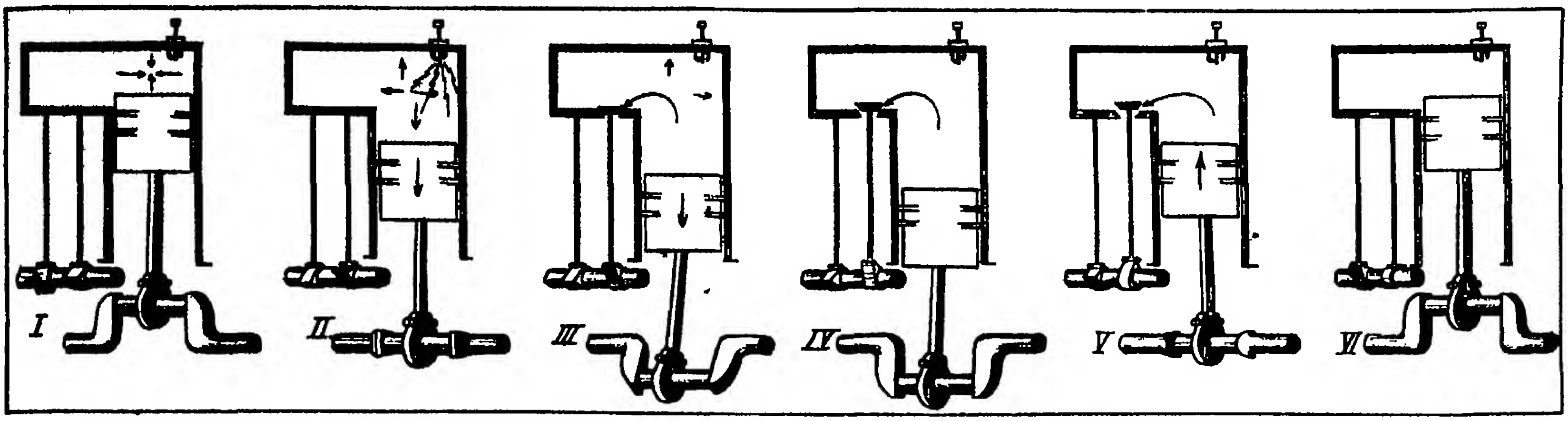
This reptilian family flourished in the period of the Liassic Formations, the most important feature of which is the large number of different specimens of Ichthyosaurus and other reptilian remains. In the Upper Jurassic strata they become rarer, and rarer still in the Cretaceous rocks. Not a single Ichthyosaurus remains from the Tertiary Period. It must accordingly be assumed that this reptile became extinct in the Upper Cretaceous formation.

Adult and infant ichthyosaurus, as restored from the fossil remains of the German fields

Development of the Asbestos Industry in Canada

A RECENT discovery was made of asbestos-bearing rock which gives promise of being of considerable value. Consul Norton F. Brand in a recent report states that the deposit is located in the serpentine rocks of the Canadian Pacific Railway connecting Revelstoke and Arrowhead and is about four miles north of Arrowhead.

The Montreal *Daily Star* recently announced that a large manufacturing plant for making asbestos products is about to be constructed in the Province of Quebec. According to this article about 80 per cent of the asbestos produced in Canada has heretofore been exported to the United States, while nearly all of the Dominion's requirements of asbestos products has been reexported from this country. It is understood that asbestos constitutes about one-half of the mineral production of the Province of Quebec.



Six successive stages in the action of one cylinder, starting from the moment when the compression stroke is completed. For full details see the text

Intake, Compression, Power and Exhaust

Successive Stages Showing What Happens Inside the Motor That Drives the Modern Automobile

ONE of the popular features of automobile shows of recent years has been the display of engines cut away in some manner and driven by electric power from outside, to display the successive steps of the engine cycle. There are always half a dozen of these exhibits, and there is always a good healthy crowd in front of each. We cannot believe that the people who go to the automobile shows lack acquaintance with the fundamentals of the internal combustion engine, yet they stand by the hour watching these exhibits turn over with their internals exposed. When the author of "Helen's Babies" put the words "I want to see the wheels go 'round!" into the mouth of little Taddie, he demonstrated the poet's statement that the child is father to the man, and gave expression to one of the dominating impulses of the civilized *homo sapiens*.

This, we believe, is sufficient justification for the pictures and text that occupy these two pages. Few of our readers are in ignorance of what we tell here. On the other hand, the things that experienced drivers do and say make it plain that all the niceties of the engine cycle are not universally appreciated. And even the reader who finds nothing here which had failed to impress itself upon his consciousness will, we hope, take a certain satisfaction in just watching the wheels go 'round.

The first attempts to make an engine which should be driven by the direct power of an explosion taking place in its cylinders, without the intermediate agency of steam to convert the heat of combustion into power, were disorderly and unsuccessful mainly because they failed to take into account the fundamental necessity for compression. A proper mixture of air and gasoline is explosive under all circumstances, but at atmospheric pressure it will not produce power to do a great deal of work. It is for this reason that Beau de Rochas, who first laid down the orderly sequence of strokes set down in the title above, is often recognized as the grandfather of the modern four-cycle engine.

Our first series of drawings attempts to follow these four parts of the cycle through in a single cylinder. We take the carburetor for granted, assuming that a means is present for supplying to the intake manifold a proper explosive mixture. We start, in Drawing I, at the point where the cylinder stands at top dead-center after the completion of the compression stroke. This cylinder stands now on the verge of doing work, the gas above the piston is under compression as indicated by the in turning arrows, and all is in readiness for the spark.

For the moment we shall take the spark for granted, too, and rest secure in the confidence that when it is due it will arrive. Drawing II shows the next stage, the spark has occurred, the gas in the cylinder has exploded, and the arrows indicate that pressure is being exerted in all directions. An explosion, be it noted, can take place in a closed chamber without anything of note happening. A certain definite pressure is produced, and if all the walls are able to withstand it they will do so, and it will be contained. In the present case, all the walls of the combustion chamber are amply able to contain the explosion, with the single reservation that the floor of this chamber, furnished by the piston, is movable. The expanding gases take the vent that is open to them and drive the piston down. Drawing II shows it on its way, moving downward as indicated by the arrow. The "throw" of the crankshaft, which a moment ago stood straight up, has been pushed around and now stands straight out in front of the plane of the paper. The camshaft which makes a single revolution to two complete turns of the crankshaft, for a reason to be demonstrated later, has made one-eighth of a turn to match the quarter turn of the crankshaft, the cams are in correspondingly shifted positions.

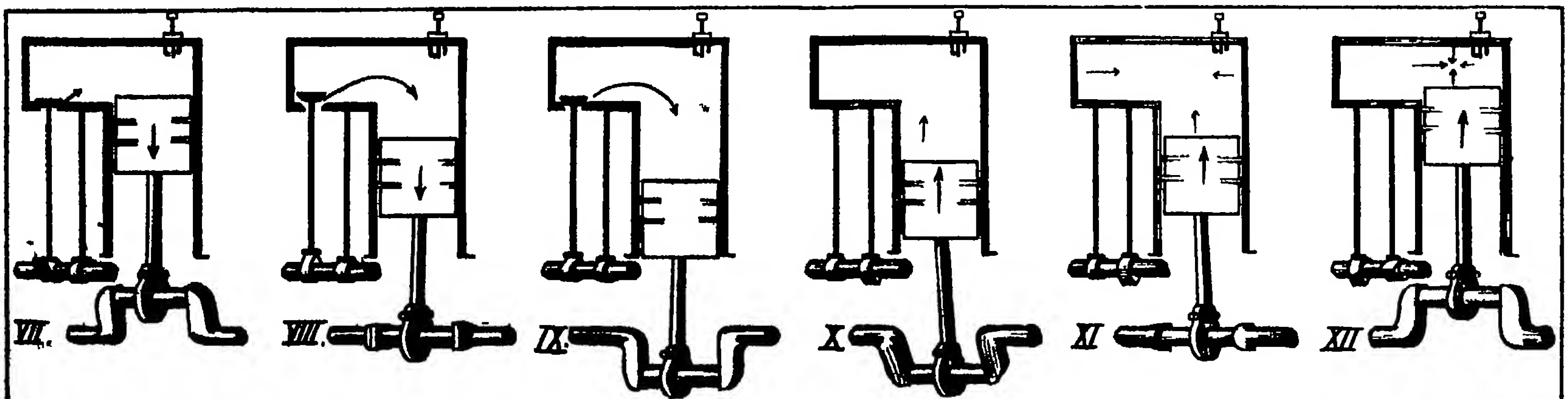
In Drawing III we are within a quarter inch or so of bottom dead-center. The exhaust cam has moved around far enough to have started to raise its push rod and with it its valve. With the crankshaft throw so near its own dead-center, the piston can not exert much push on it in any event; the infinitesimal amount of power lost by what might at first blush seem the premature opening of the exhaust valve is more than compensated for by the acceleration given to the exhaust process by this early opening. For there is going to be a real loss of power if we attempt to explode the next charge, when its time comes, without having cleaned out the burned gases thoroughly. In this drawing we still have the gases in the combustion chamber expanding, pushing in all directions, and incidentally passing to some degree out through the partly opened exhaust valve and thereby lightening the task which the piston must perform on its upstroke.

Drawing IV shows the piston at the end of its down stroke at bottom dead-center, and the exhaust valve is open a trifle wider. The piston will not move any further so that the cylinder is impervious to the expansive force of the gas save at the one point where we are only to glad to have it yield—at the exhaust valve. The only action of note that is taking place in the gas is therefore its continuing escape through this valve.

In Drawing V the piston has gone well along on its upward stroke, we see the crankshaft throw up and out behind the plane of the paper. This is the exhaust stroke, the gas may still have a certain amount of expansive action left in it but that is immaterial. The piston is actively engaged in driving it up and out through the now wide-open exhaust valve, the heel of the cam (in a cam of this shape it seems as though it might better be designated the toe) being at its highest point.

The sixth sketch depicts the next significant stage. The piston has again reached the dead-center at the top of its stroke, and the absence of an arrow to indicate its direction makes it plain that it is again momentarily checked. The exhaust valve has closed completely, in anticipation of the opening of the intake valve which is to follow. At the stage shown here, nothing is happening in the chamber above the piston head, the exhaust has been completed, the intake has not started. So we have no gas flow at all, and no arrows to indicate any.

As soon as the piston starts its downward stroke the intake valve of course must start to open in order to get the full benefit of the suction from the motion of the piston. Drawing VII shows that this condition is met, Drawing VIII shows the intake stroke at its center, with piston and crankshaft in about the same position as in Drawing II, but with the cams and the valves quite otherwise, and Drawing IX shows us at the end of the stroke, at bottom dead-center again. Here we are about to start up on the compression stroke, and it might seem that the intake valve should have closed in expectation of this. The fact is, however, the in drawing force at the valve is so persistent that we can afford to permit the closing of the latter to drag along a wee bit into the compression stroke. It need not close completely until the gas in the cylinder shall have had



The rest of the cycle, carrying things through to a duplication of the state of affairs seen in Drawing I, above

time to transmit the compressive force of the moving piston from the bottom to the top of the cylinder. But Drawing X shows us that as soon as any appreciable distance has been travelled by the piston in its upward, compressive way, the intake valve is seated. Drawings XI and XII show the completion of the compression stroke, and bring us to the beginning again.

Careful comparison of Drawings III-VI with numbers VI-X will show that the intake valve and the exhaust valve do not correspond exactly in their action. The exhaust opens before the piston reaches bottom dead-center and is closed at the instant when it arrives at top dead-center. The intake valve, on the other hand, opens a shade after top dead-center and closes a shade after bottom dead-center. This result, it will be appreciated, requires that the two cams be set not at exact right angles to one another, but at an angle a trifle wider than this, so that the intake action follows the exhaust at an interval slightly greater than a quarter revolution of the camshaft or a half revolution of the crankshaft. As here pictured, the two valve actions take the same actual time and the action of each valve in opening takes the same period as the action of the same valve in closing. If it were desired to depart from these conditions, the periods of the valves could be made to differ by having the intake and the exhaust cams of different shape, while the half periods of a single valve could be made to differ by having the cam unsymmetric—sloping more sharply on one side of the heel than on the other.

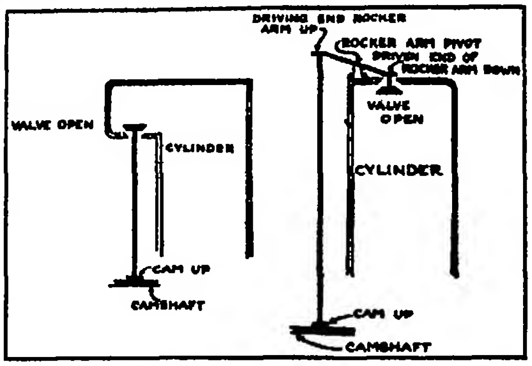
The valve action and the shape of the cam have been copied, in these drawings, quite faithfully, from a particular engine of a particular brand of automobile. Aside from this, it will be realized that liberties have been taken in the drawings, which are rather crude in a number of respects. In particular the alcove that carries the valves is not, in fact in front of the cylinder chamber or behind it but in every engine is actually at one side so that the valves stand side by side in the direction parallel to the crankshaft. For simplicity of drawing we have turned the alcove around, and at the same time so pictured the valves that they may both have their push rods resting on the cams of the single camshaft. Of course no sane designer would set up his engine in such a way that the intake would have to pass across the exhaust valve, covering a superfluous distance of two inches or more. Other departures of our drawings are likewise made in the interests of clear diagrammatic representation, and will be so understood.

We have shown the valves on our typical cylinder as of the poppet type. More and more, engine-builders are availing themselves of the advantages of the overhead valve in the top of the cylinder casting, so a word ought to be said about this. Its big feature is that it eliminates the alcove, and makes it possible for the intake and the exhaust to proceed without running around a corner. The incoming gas enters the main body of the combustion chamber at once, the exhaust gases leave that chamber directly via the valve. Curiously enough, the introduction of the overhead valve requires no modification of the cam setting, in spite of the fact that the valve-head must move downward to open and upward to close, in reversal of the poppet-valve action. The push rods are merely made longer—sufficiently long, in fact, to project into the clear on top of the cylinder casting. A rocker arm is then provided, running from the end of the push-rod to a short valve stem. When the push-rod moves up, this rocker drives the valve down, and, as our drawing inserted for the purpose shows, the two styles of valve are in precisely the same position for the same position of the cam. It is even possible to introduce a lever-ratio effect by allowing the valve end of the rocker arm to be longer, from pivot to bearing point, than the driving end that bears on the push rod. In this way the valve travels faster than it can with the direct drive from the push rod, and so may open wider without any loss of time.

The action of a single cylinder is by no means all there is to the automobile. The several cylinders have to be so arranged that they will all contribute, in equal share, to the driving of the shaft. It is here that the fundamental divergence comes in between fours and sixes, and between all in-line and V type engines. We have not space to picture them all, and must therefore content ourselves with a few generalities.

Every piston, it will be realized from what we have already shown, must make two complete return trips down and up again in its cylinder for its complete cycle, and that means that the crankshaft must rotate through two complete turns for a single cycle of the cylinder. In other words, the individual cylinder delivers a power stroke not once on each turn of the shaft, but once on every two turns. This is the feature that separates the four-cycle engine from the steam engine and the two-cycle type generally, where work is done on both sides of the piston so that a power stroke is delivered on each revolution of the crankshaft. Pursuing the matter further, this is the reason why the four-cycle engine is always a multi-cylinder affair. A single cylinder can hardly deliver enough energy on the work stroke to carry the crankshaft through a turn and a half, drive the piston through three parasitic strokes, and in addition deliver energy to the transmission system.

The cylinders must, however, be arranged so that two demands are met. The power strokes from the several pistons must come at evenly distributed intervals



The relation between valve-head and cam is exactly the same in both types, despite the reversed direction of opening

Poppet valve vs. overhead type

through the two revolutions of the crankshaft that correspond to the single cycle of the entire engine, and they must be so distributed spatially along the shaft, from front to back, as to keep the latter evenly balanced. The latter condition is not so clear when expressed in words as the former, what it means may well be appreciated by a glance at our drawing of the complete four-cylinder engine.

It will be noted that here the two end throws of the crankshaft are shown down, with the pistons corresponding to them at bottom dead-center, while the two center throws are up, at top dead-center. This, it will be understood at once, results in an even distribution of the up and down moments about the center bearing of the crankshaft. If, without proper thought, the cylinders were allowed to fire in order from front to back, the first and third throws would be down while the second and fourth ones were up, and the unbalanced pressures would destroy the center bearing in short order, if not the crankshaft in the bargain.

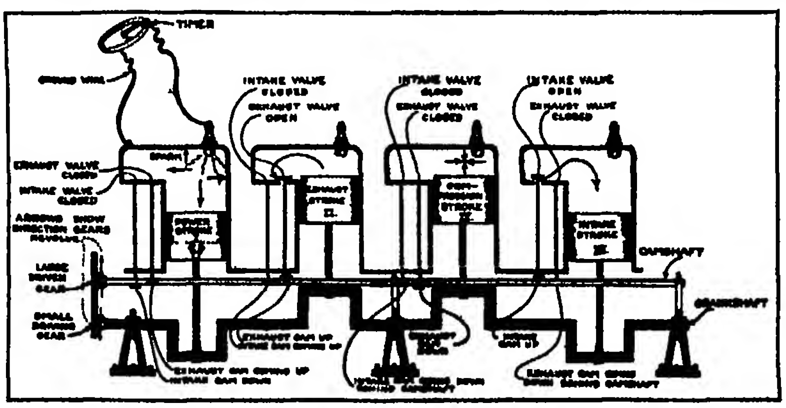
The six-cylinder engine, of course, presents three explosions and three power strokes for each turn of the crankshaft, while the four-cylinder type presents only two. This means that where the successive cylinders in the four (in order of firing, not in order from front of the engine to back) have their crankshaft throws exactly opposite one another at angles of 180 degrees, the corresponding angle in the six is 120 degrees. The great advantage of the six inheres in this circumstance, for where we show the four with all pistons at dead centers simultaneously, this cannot happen on the six, which must always have at least four of its six cylinders somewhere in the middle of a stroke, with never more than two of the six at a dead-center. This explains why the light six-cylinder cars make gasoline-mileage practically equal to that of the best fours, while the eights and twelves of necessity base their extreme smoothness of operation upon a larger consumption of fuel.

We have selected the four for full diagrammatic representation of the entire engine-cycle, and have retained the conventionalized crudities that make for more convenient diagramming. We are now able to show the relation between the crankshaft and the camshaft. The driven gear at the end of the latter is twice the size of the driving gear at the end of the former, so that the camshaft turns once while the crankshaft turns twice. Reflection will show this to be a necessary consequence of the four-stroke cycle; it could be avoided only by the use of separate camshafts for intake and exhaust valves. Arrows emphasize the fact that with a simple gear arrangement like that pictured, these shafts revolve in opposite directions.

No comment is necessary upon what is taking place in each cylinder individually, since in every case one of the stages shown in our first twelve drawings is reproduced. The point here is rather to exhibit clearly the succession of power, exhaust, intake and compression, as well as the succession of power strokes through cylinders 1, 2, 4, 3 when numbered in accordance with their position along the axis of the engine. The cams have been still further conventionalized, and this time the arrangement of all eight of them appears.

No effort is made to indicate the manner in which the timer or distributor, for producing the spark at the right time in the right cylinder, is geared or connected by chain to the ultimate source of its driving power. It, like the camshaft, must rotate once to two turns of the crankshaft, it may be driven by one-to-one gear off the camshaft gear, or by a similarly geared chain off the camshaft. The point in showing it at all is to indicate a little more clearly where the spark comes from. Assuming that we have a sparking current in the wires, it is plain that as the brush passes over each contact, this current flows to the plug in the corresponding cylinder and there gives the spark. We show only the wire leading to the cylinder that is actually firing.

The distributor is the one element in the timing of the engine that is flexible (as the spark-lever indicates). The slower the engine speed, the further the spark must be retarded to give the maximum of power, the greater the engine speed, the further it must be advanced in the same search for maximum force. Perhaps the reason for this is not clear to every driver. Reflection ought to make it plain that the slowing or speeding of the engine does not in the least affect the relative timing of pistons and valves, it affects only the actual values of their several speeds. On the other hand, the combustion and explosion velocities of a mixture of air and gasoline are entirely definite, and nothing we do to the engine can affect them in the least. When we slow the engine, or speed it up, we therefore *do* alter the ratio between the piston speed and the speed at which the gas acts in the combustion chamber. If we slow the engine materially the explosion takes place at the same old speed and will reach the piston head and begin to do work thereon before we are ready for it to do so, to prevent this, we retard the spark and start the explosion later. When we speed up the engine beyond the velocity of gas explosion, we similarly must advance the spark in order to make certain that the expanding gas shall reach the piston head soon enough.



The essential features of the full cycle of the four-cylinder engine, shown in diagrammatic form (cylinders numbered in order of firing)

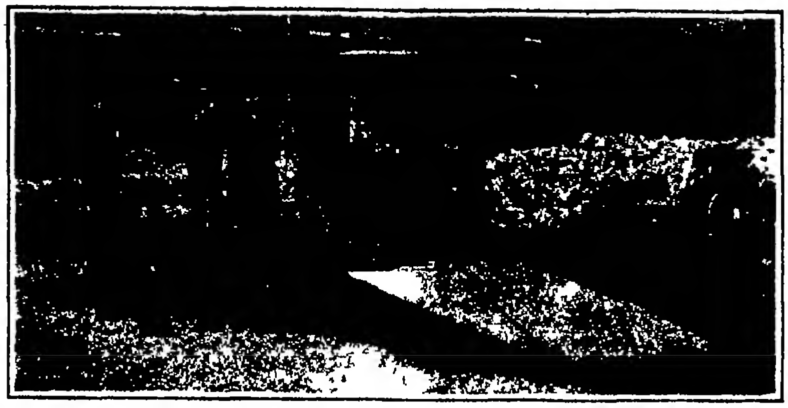
The whole sequence of events that take place inside the gas engine is admirably designed to bring out the true significance of minute intervals of time. The Greeks had their celebrated paradox of Zeno, which was a permanent puzzle to them because, admitting the possibility of dividing space again and again and again into as small intervals as we choose and admitting the reality and the significance of the parts into which it might thus be divided, they refused to divide time similarly into indefinitely small pieces. We are apt to share this feeling that there comes a point beyond which further shortening of the time dealt with lacks significance. If we will but reflect that pistons make up to 2000 trips up the cylinder, and 2000 trips down it, and 4000 dead stops and reversals of direction, in 60 seconds, we ought to be convinced of the reality of minute time intervals. There is time, and to spare, for the proper sequence of all the things that must take place to complete a complicated engine cycle which lasts for but 6 one-hundredths of a second—even when the item under consideration is the halt at dead-center which can only be allowed a small fraction of this already minute period.

Trolley Snow Sweepers

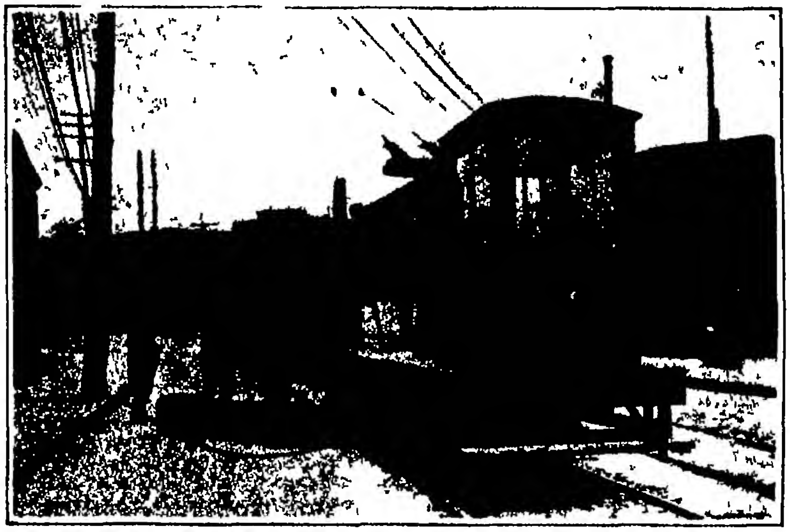
BY means of new devices, Cincinnati street car tracks and streets are to be kept free from heavy snows and coatings of ice which in the past have proven big obstacles to traffic. They have been officially adopted by the Cincinnati traction company, and formally approved by those city officials having supervision over the company

The new equipment consists of seven cars equipped with snow-pushing "wings" which are 12 feet long and when spread out for action clear a width of 7 feet outside the car track. These "wings" are also equipped with extensions of heavy steel folded over like a jack-knife which when opened up clear several additional feet. This contrivance may be termed a "mopper-up" and clean the street for the benefit of other traffic.

Another piece of equipment is a large car provided with an apparatus for the removal of ice. On the front of this car is attached an apron provided with steel teeth, for the cleaning of ice from the tracks, which forms after snow melts. This machine, it is said, will do the work of 200 men. It is also planned to equip trucks with "wings" for use on streets where there are no car tracks.—*By R. C. Kroger.*



The scraper that clears away ice and frozen snow

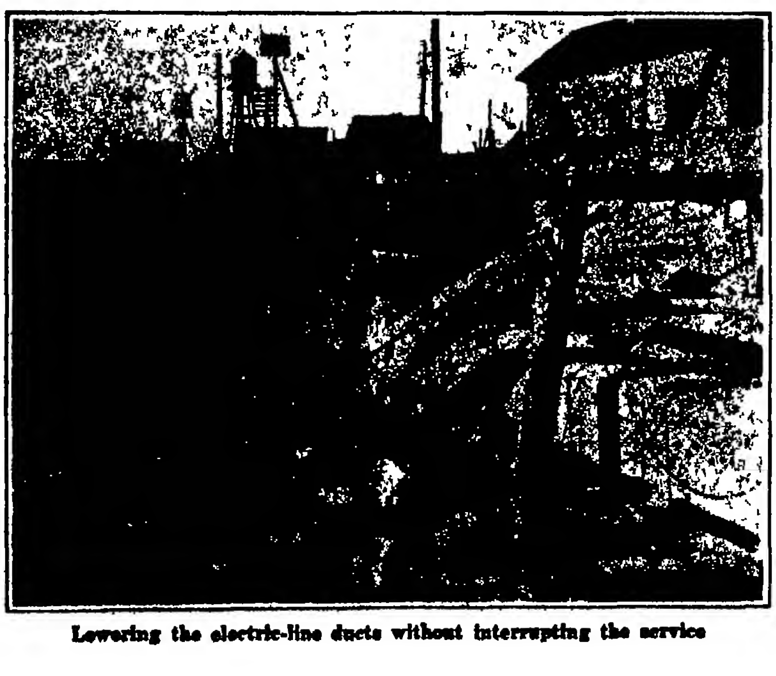


Using the trolley sweeper to clear snow from the roadway

Electric Service Continued while Duct Line was Lowered

IN Minneapolis recently a two-line underground duct was lowered 12 feet through a total length of 1100 feet without any interruption to the electric service. At the point where this work was accomplished the roadway was depressed 12 feet in the process of eliminating a grade crossing, and the suspension method of lowering the ducts was resorted to in order to gain continuity of service

The street was cut away on either side of the ducts to the required grade and then the ground was cut away from under the ducts at 10-foot intervals. Under the ducts a trestle of cross-ties and uprights was erected in the openings and two sets of planks were placed on edge on top of the trestle parallel to the road Bolts passed between the two timbers carried a nut and washer and this formed a carrying support for the ducts. Short cross-ties were slipped under the duct line a short distance apart and a loop of guy wire was passed around each end of a tie and on through a pivoted eye on the lower end of the bolt. All the bolts were adjusted to take up the tensions, and the remaining earth was removed with a scoop shovel Then the ducts being in complete suspension were ready for lowering. To lower the lines the nuts on every other pair of bolts were given three turns and then the alternate supports were lowered by three turns of the nuts. Upon reaching the bolt ends the nuts were taken off every other pair of bolts, and the guy wire loops were lengthened out by about the length of the thread on the bolt. After the bolts were placed back the nuts were screwed down to take up the strain. This process was repeated until the ducts had reached their new level Then the bolts and loops were removed and the trestle demolished.—*By Allen P Child.*



Lowering the electric-line ducts without interrupting the service

Daily News and Concerts by Radio Telephone

THE Westinghouse Electric and Manufacturing Company announces that it has opened a radio telephone broadcasting station at its plant in Newark, N J., and, with the cooperation of the *Newark Sunday Call*, is supplying news and concerts which can be heard by wireless operators within a radius of 200 miles.

Every night beginning at 8·05 Eastern Standard time, an entertainment consisting of a digest of the day's news, Government reports, and a musical selection is given. A special feature of the entertainments is a children's hour every Friday night at 7 o'clock, when songs and stories for the youngsters will be radiophoned.

During the World Series baseball games, every ball, strike, and other play was reported as soon as made from this station, so that thousands were able to enjoy the games. Similar service will be provided for the major football games and other important sporting events, the fact that these occur strictly on schedule makes them more eligible for such treatment than the more serious news of the world Elections, however, can always be covered, as can market quotations, important court decisions, big sporting events and anything else that happens on fixed schedule or at a time known in advance

The Westinghouse Newark station operates on a wave length of 360 meters, and its call letters are WJZ. It should be easily heard as far south as Baltimore and as far north as Albany, while under favorable conditions, the messages should be audible in practically the entire area east of the Mississippi River, and as far afield as the Bermuda Islands.

Testing of Thermometers

THE previous edition of this Circular of the Bureau of Standards contained, in addition to the testing regulations, much general information on thermometry and temperature measurements. The present, or third edition of Circular 8, has been very much shortened by including only the information which is essential to those who avail themselves of the Bureau's testing facilities. The Bureau's standard scale of temperature is defined and the method of reproducing it is briefly indicated A new feature of the circular is the inclusion of definite testing requirements and of tolerances as to correctness of graduation Thermometers meeting the requirements as to suitable design, material, and workmanship will, if found correct within the established tolerances, be certified, others will receive reports giving the result of the test. Notes on the behavior of thermometers which are included in the circular are intended to give the user of these instruments the information necessary for an intelligent application of the results of the test. Explanations are given of the reasons why the applicant for test must assume all risk of breakage either in shipment or test. The circular contains general instructions concerning packing and shipping and schedule of fees for testing

The circular may be obtained from the Superintendent of Documents, Government Printing Office, Washington, D C.

Zinc Cyanide Plating Solutions

ZINC coatings furnish by far the best protection from corrosion of steel, and for this reason zinc plating or electrogalvanizing was extensively applied to all sorts of machinery during the war Satisfactory zinc deposits can be secured from either sulfate or cyanide solutions, but the latter possesses the advantage of "throwing" the deposit better into deep depressions or upon the surface of irregularly shaped articles. The cyanide solutions were, therefore, given first consideration in the investigations conducted by the Bureau. It is hoped later to extend this study to include the sulfate solutions. It was found that satisfactory zinc cyanide plating solutions can be made by using zinc oxide to replace part or all of the zinc cyanide formerly employed for this purpose

Technologic Paper No 195 of the Bureau of Standards describes the above work and gives formulae for satisfactory solutions and general directions for their use

Concrete Tower for Dam Construction

OUR cover this month shows the concrete tower 172 feet in height which has been built to carry the mixture of concrete up to the different levels for construction of the Hetch Hetchy dam, from which a large part of California will ultimately be served with hydroelectric power The dam is to be built in two sections, the first being 226½ feet above the stream bed, and the ultimate crest 312 feet high. As the dam goes up, the height of the tower will be increased correspondingly, so that at all stages of the work it will give ample pouring head.

The aggregate is delivered directly to the mixers by small locomotives. A narrow gage railroad was constructed running from the dam site along the side of the valley a distance of some 7,000 feet to a rock quarry at the foot of Wampama Falls.

Excavation was carried to a depth of 72 feet to provide a solid foundation for the dam, numerous pumps being required to unwater the site These big towers add further evidence to the numerous text and pictures which have already served to give the readers of the SCIENTIFIC AMERICAN some idea of the magnitude of the whole undertaking.

Our artist has given a good idea of many of these phases of the work, and has shown how operations are conducted on a 24-hour basis with the aid of huge floodlights that draw their power from that part of the project already completed.

The Service of the Chemist

A Department Devoted to Progress in the Field of Applied Chemistry

Conducted by H. E. HOWE, Chemical Engineer

The Effect of Oils, Greases and Degree of Tannage on Russet Harness Leather

THE result of a series of experiments conducted at the Bureau of Standards is reported in Technologic Paper No 160. The variation in tensile strength, stretch and buckle strength in leather from different parts of the hide is given for six sides of leather. It has been found that variations in the amount of oils, both mineral and animal, and of medium and heavy tannage, as well as the amount of stuffing, has a bearing on the physical properties and there is a point beyond which these materials do not add to the strength, and indeed may actually decrease it.

It was also found that the tensile strength is greater for leather tanned for a short time than for that given a long tannage. This also affects the firmness of the leather, the longer time tannage producing leather more resistant to sheer when used near a buckle. Mineral oils of the type used in the experiment did not affect the physical properties of new leather in any degree substantially different from animal oils.

Ductile Nickel-Cobalt

RESEARCH continues to uncover the reasons for the behavior of different compounds to such a degree that one can not fail to wonder why many industries or individual concerns in an industry hesitate to support research. For example, the alloys of nickel and cobalt have always been non-ductile at ordinary temperatures, but it has remained for Colin G Fink to learn that this non-ductility is due to the presence of carbon in the alloy, and that when such a non-ductile alloy is freed from carbon, sulfur, phosphorus and basic impurities it becomes ductile. An alloy containing 20 to 30 parts of cobalt and 90 to 80 parts of nickel produced in an electric furnace using an alundum crucible under circumstances which preclude contamination with the impurities mentioned above and to which, when melted, two parts of manganese are added, may be rolled from one-half inch down to two one-hundredths of an inch without intermediate annealing. Such an alloy is suitable as a support or a current lead wire for electric lamps. It has low heat conductivity, and therefore increases the efficiency of electric lamps, particularly in the case of those of low voltage.

Waterproofing Paper

A BRITISH patent has been granted for a new method of waterproofing paper to such an extent that it may be used as a substitute for rubber or leather in making diaphragms for gas meters, etc, or for the manufacture of small articles like purses. The patent is abstracted in the October issue of *Chemical and Metallurgical Engineering* and states that the material is prepared by impregnating long-fibered paper with a warm solution of animal and vegetable glutinous substances. After drying, whale oil or a fat is rubbed into the treated paper. The long-fibered Japanese paper is considered preferable, and the following impregnating solution is considered suitable: Gelatine one part, arrowroot one part, potassium bicarbonate one-half part, calcium chloride or glycerine three parts, and to reduce flammability, three parts of ammonium carbonate are added. These materials are all dissolved in one hundred parts of water. When brittleness is not a factor, gelatine alone may be used, and the treatment with fat or oil alluded to above is necessary only when the material is to be subjected to alternate wetting and drying.

Coal Gas Composition

ANNALES DE CHIMIE for May and June report results of experiments by Vignon on the relation of temperature to the composition of gas obtained by the distillation of coal. In the series various coals were heated at 400, 600, 800, 1000 and 1200 degrees Centigrade, until only very small quantities of gas continued to come off at that temperature. A number of conclusions are reported. The unsaturated hydrocarbons distill below 600 degrees and are broken up at higher temperatures. The saturated hydrocarbons distill up to 800 degrees in large quantities, that is, up to 84 per cent, but this percentage diminishes rapidly at still higher temperatures. Most of the hydrogen comes off between 800 and 1000 degrees, and less than 10 per cent of the carbon monoxide comes off below 1000 degrees. When the temperature of distillation is increased a greater volume of gas is obtained, but this gas is of low heating value and contains on the average greater amounts of carbon monoxide.

The Value of Planting Trees to Supply Raw Material for Chemical Industries

NOT so many years ago it was considered necessary to establish a tannery in the woods where it could be near large supplies of the various bark required. More lately methods for preparation of concentrated tanning extracts were developed and the newer tanneries have, in general, been placed with reference to easy access to a supply of hides and skins, to which it is cheaper to bring the concentrated extract than to transport the green hides to the bark. Part of this change comes about through the disappearance of suitable trees, and in Germany the Central Union of the German Leather Industry is now urging that more attention be devoted to the planting of chestnuts, not as a substitute for oak, but as a means for increasing domestic tannin production. The bark, as well as the wood, of the chestnut contains tannin, and one investigator has found that at the age of 15 to 25 years the chestnut will yield from 4 to 7 times as much tannin as the oak of the same age from oak plantations. The plan seems to be to replace the oaks as they are removed by setting out chestnuts.

While it is true that the present scarcity of wood or methyl alcohol in the United States is due in large part to the demand for formaldehyde used in the treatment of seeds, etc., and as a raw material in the preparation of organic accelerators for rubber vulcanization, it is also true that several wood distillation plants have been compelled to cease operations for lack of raw materials. Notwithstanding the efforts made on the part of the authorities and some private interests to practice reforestation, the subject seems to be one to which more attention is given in conversation than in actual practice. The development of different chemical industries in our country may bring added pressure to bear to accomplish the type of reforestation work which has long been advocated.

A New Cooperative Movement

UNTIL the organization of the Crop Protection Institute, under the auspices of the National Research Council, on September 28, following the preliminary conference held last June in Rochester, N Y., there have been no adequate facilities for close cooperation between the various scientists interested in combatting injurious insects and plant diseases and those who manufacture the materials and appliances used in such work. The new Institute represents all of these groups, and through its activity it is planned to conduct regional conferences and cooperative experiments to the end that more rapid progress may be made in devising new methods for insect and plant disease control. None of the present work will be duplicated, but an effort at coordination will be made and there is every reason to believe that the public will eventually benefit to a marked degree.

The importance of such cooperative work may be emphasized by the work before us in controlling and if possible eradicating the bean ladybird. The insect has arrived from Mexico and is establishing itself among the leguminous crops of Alabama. Unless it can be controlled this insect threatens the bean crop of the United States. So far as we know now, the ladybird has no natural enemies, and as it clings to the underside of the leaf it is difficult to reach with sprays and dusts. Unlike most insects, two-thirds or three-fourths of the individuals are females, each of which may lay 750 eggs in a season. It is evident that to wage war on so dangerous an insect requires the fullest amount of cooperation on the part of state and federal authorities, as well as others. The work of an insect of this sort could readily undo all that the bollweevil has taught the South concerning the benefits of crop rotation and the growing of leguminous plants on soil where the bollweevil makes cotton raising commercially impossible.

Renewing Worn Files

PUBLICITY has just been given to a method for renewing old files which consists first in cleaning them with a "file card," after which they are placed in a mixture of four ounces of washing soda and one quart of very hot water, in which mixture they are then scrubbed with a brush to remove oil, dirt, etc. The acid mixture to which the files are then transferred consists of four ounces of sulfuric acid in one quart of water. It should be remembered that when diluting sulfuric acid with water sudden heat is developed such that if the water is poured upon the acid dangerous spattering will occur. The acid should always be poured into the water very slowly and the solution stirred with a piece of wood or a glass rod. The old files remain covered in the solution for from 10 to 12 hours, after which they are thoroughly washed in water, dried, and oiled.

A Chemical Method for the Detection in Fruit of a Prior Frozen Condition

THIS is the subject of an interesting article by Dehn and Taylor in the October issue of the *Journal of Industrial and Engineering Chemistry*.

"Modern methods of cold storage of fruits sometimes raise the question whether too low temperatures have been employed, resulting in abnormal deterioration when the fruit is removed from storage. For example, pears are held at a lower temperature than peaches, and if both are held at the same temperature the peaches may be injured. The question arises whether fruit which has been frozen or only partly frozen can be distinguished from fruit not subjected to these low temperatures.

"Extreme cases of frozen fruit can, of course, always be recognized after thawing by the mushiness and darkening of the pulp, by the modified taste, and by the rapidity of rot. Between the extreme frozen condition and the non-frozen condition cases arise that can not be judged by such obvious indications."

The authors, therefore, undertook to devise chemical and other methods for the examination of fruits in such cases and found that advantage could be taken of divergencies in the largest components of the fruits, particularly the variation in the ratio between invert sugar and sucrose. Inversion subtracts from the sucrose concentration and adds to the invert sugar concentration, thus giving accurate measurements of such divergencies which can be determined by standard gravimetric methods of measurement. Sucrose is inverted during ripening, overripening, rotting and freezing, and the invert sugar itself may be destroyed by chemical decomposition, the metabolism of the plant or the actions of yeasts and molds. Molds consume a large part of the invert sugar, or at any rate feed upon it rather than upon sucrose, so that should great deterioration take place in the case of the samples the method suggested is not reliable.

Other Meat

SOME months ago reference was made to experiments conducted by Trowbridge at the Experimental Station of North Dakota in utilizing horses beyond the effective work age as a source of food supply to supplement beef. He found that dried horse flesh from a horse 18 years old was more tender and just as palatable to the average person as high-grade dried beef.

The Office of Home Economics, United States Department of Agriculture, has been working upon a comparison of the edible portion of the flesh of the kid, rabbit, horse, and seal, and it has been found that the digestibility of these meats, or of the protein of the four kinds of meat, is substantially the same as that of any of the other, and better known, meats.

Whenever experiments of this sort are made we are reminded of the prejudices of the average consumer, but it was noted from the conversation of those partaking of the various dishes that those who were being treated to cakes of horse-meat found nothing unusual about them, and thought they were a good variety of "hamburg steak."

Why Not Long-Distance Stenography?

THE usual dot and dash language comprising the Morse code of wire and wireless telegraphy is rather a crude piece of work. That is to say, it depends on the differentiation between dots and dashes and spaces and even the slightest error in making a proper differentiation leads to serious errors in the transmission of dispatches. Obviously, it is a delicate language, this Morse code, especially in long-distance radio telegraphy where the receiving operator's ears must strain to catch the faint signals, or where the photographic recorder takes down the signals and parasitic disturbances with equal facility and it is for this reason that there is so much repeating of messages in radio telegraphy, in order to insure accuracy even under the most adverse conditions.

The Belin system of image transmission over wires and via wireless may yet bring about a revolution in telegraph and wireless systems. For with this system it becomes possible to transmit images instead of mere dots and dashes, and there are far less errors possible with such images than with the delicate Morse code. Originally the Belin system was identified with the transmission of photographs over wires and even by radio, but it now appears as though the transmission of facsimile handwriting, typewriting, odd characters such as those of the Chinese alphabet, and even stenography may prove to be the more fruitful field in which to apply this ingenious invention.

The Belin system has been described in past issues of this journal at the time when it was employed in transmitting photographs between St. Louis and New York City, and more recently when this system was employed in transmitting drawings from the Annapolis radio station to Malmaison near Paris France and the facsimile handwriting of Premier Briand and General Pershing from the American-built Lafayette radio station, near Bordeaux France, to Bar Harbor Maine.

However, a brief description of this system is again given here, together with the accompanying schematic drawings which are virtually self-explanatory. It will be noted that the transmitting device consists of a motor-driven cylinder on which is placed the image to be transmitted. A certain process causes this image to form in relief on the brass cylinder. As this relief image is rotated there presses against it the point or stylus of a microphone. Obviously, as the stylus is more or less pressed by the irregularities of the relief image, the current flowing through the microphone is likewise varied or modulated, thus giving an electrical interpretation of the relief image. This varied or modulated current can be sent over the wires of a telegraph or telephone line, or can be employed to control a continuous wave wireless transmitter.

The receiving end, which may be connected to a telegraph or telephone line or to a wireless receiving set, as the case may be, is somewhat more involved. As will be noted by studying the receiving side of the accompanying drawing, the incoming current is led to the fine wires of a Blondel oscillograph. These parallel silver wires, passing down between the poles of a powerful electromagnet, carry a small mirror, which swings on its vertical axis with the fluctuations in the current passing through the parallel wires. A beam of light from a powerful arc lamp is directed on the tiny mirror, which in turn reflects the beam on to a graduated screen. This screen is opaque at one end and transparent at the other with varying degrees of transparency between both extremes. Obviously as the mirror turns on its axis in response to the fluctuations of the incoming current, which in turn represents the varying values of black and white represented in the image at the transmitting station it rests on the corresponding section of the graduated screen. More or less light therefore passes through the screen and through the lens at the rear which guides it to the aperture of a light proof case. Inside the light proof case is a motor driven cylinder that carries a piece of photographic paper or film. Thus the varying values of light are impressed on the sensitized paper or film as it is revolved at the same speed as the cylinder at the transmitting end, an ingenious synchronizing device being employed for the purpose. The image is thus formed in a helix, so to speak, with the successive lines of the helix practically overlapping. It is the fineness of the threads of this helix that that determines the texture of the received photograph.

Details of the Belin system of image transmission over wires and by radio, as arranged for photographs and other so called half tone subjects

The process just described applies to the transmission and reception of photographs in which all tones from black to white must be handled. The transmission of plain black and white matter such as facsimile hand writing type matter drawings maps and so on is considerably simpler. The microphone is replaced by a plain make-and break device equipped with a stylus while the graduated screen is dispensed with at the receiving end. In this arrangement the stylus either makes or does not make a contact and current either flows or does not flow through the line or through the radio transmitter. At the receiving end the mirror either turns so that the beam is directed into the aperture and on to the sensitized surface or it does not turn, hence no light falls on the sensitized surface.

In view of the fact that long-distance radio stations are often tied up for hours at a time because of the atmospheric conditions which break up or muddle up the delicate dots and dashes of the Morse code the Belin system is highly promising. In fact, M Belin has given serious thought to the use of stenography in connection with his system. Thus a message to be transmitted could be written in shorthand specially treated to bring it out in relief and then placed on a drum for transmission. Instead of the delicate arrangement of dots and dashes the message would then consist of facsimile reproduction of the shorthand notes at the receiving end, which could be read off by a skilled stenographer. Even with atmospheric disturbances or static at its worst there would be sufficient of each outline present in the received images unmistakably to read the messages. In the case of the telegraph code the static breaks up the arrangement of dot dash and space thus changing the entire meaning of the received signals whether they are received audibly on a photographic tape recorder.

In the case of Chinese characters the Belin system is of greatest import. Chinese can not be spelled phonetically as is the case with Japanese. Furthermore it is practically impossible to form a sufficient number of dot and dash combinations to represent the hundreds of letters of the Chinese alphabet. Heretofore the practice has been to translate the Chinese dispatches into some other language that does admit of telegraphic interpretation, and to translate that language back into Chinese at the receiving end. An awkward and dangerous practice true but it was the best available. The Belin system now makes possible the transmission of the Chinese characters themselves thus marking a vast stride forward for Chinese and all other languages which are to be handled in their original form over wires and wireless alike.

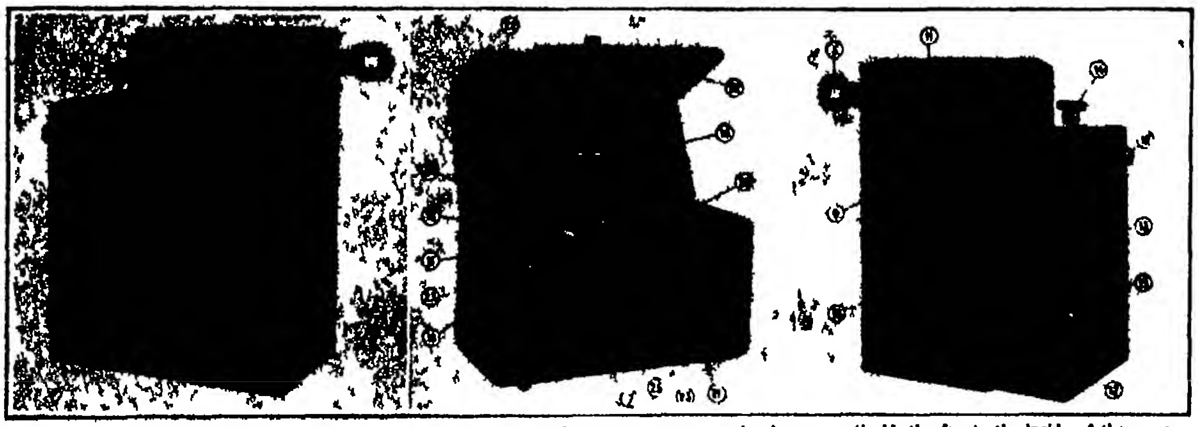
Production of Liquid Air

WHILE liquid air has been produced in the laboratory and on a commercial scale for many years but little information is available in printed form concerning laboratory plants for its production.

Scientific Paper No 419 of the Bureau of Standards has just been issued and may be obtained from the Superintendent of Documents, Government Printing Office Washington D C at 5 cents a copy. It appeals to anyone interested in the subject.

Combining Motion Pictures with Clockwork

FROM France comes an ingenious motion picture camera of compact dimensions. In fact the little camera measures 4 by 5 by 6¼ inches yet it contains a highly finished mechanism capable of exposing 250 separate pictures on a strip of ordinary motion picture negative film 20 feet long either in the form of motion pictures or as separate snapshots or time exposures.



Three views of an ingenious camera for making motion pictures and separate exposures showing respectively the front the inside of the camera proper with film gate sprocket wheel and film spool shafts and the rear of the camera, showing the sliding shutter raised for focusing directly on the film or for enlarging the counter indicating pictures exposed clockwork mechanism and knob that sets the mechanism for motion picture work snapshots or time exposures

A French camera that combines clockwork with motion picture mechanism so as to make an all-round hand camera

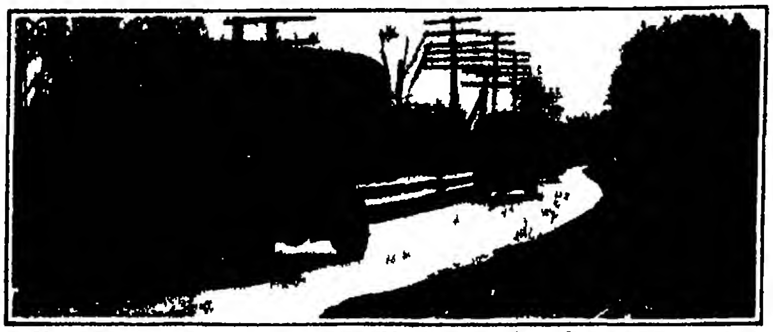
The entire mechanism of this new camera is automatic. The camera is made of metal throughout and consists of two parts first the camera proper secondly the mechanical motor attachment. The motor mechanism is of the clockwork pattern and supplies the necessary mechanical energy for the taking of motion pictures or separate exposures. It is wound with a fixed key. The mechanism is released by pressing a button. An indicator at the side of the camera shows whether the mechanism is set for motion pictures time or snapshots. The film shifts automatically.

The camera is supplied with the usual motion picture lens with an extreme aperture of 3.5 and a 2 inch focus. A view finder is provided on the left hand side of the camera and can be used for either upright or horizontal pictures. To permit of the loading and unloading of the camera in daylight the film is enclosed in a special box which opens and shuts in the interior of the camera by an ingenious attachment on the out side of the case. Other features are an indicator which shows the number of pictures exposed a sliding shutter which allows direct focusing on the film and the using of the camera as an enlarger a device for using the camera as a printer and a screwhole with universal thread for fixing the camera on a tripod.

The Motor-Driven Commercial Vehicle

Conducted by MAJOR VICTOR W PAGE M S A E

This department is devoted to the interests of present and prospective owners of motor trucks and delivery wagons. The editor will endeavor to answer any question relating to mechanical features, operation and management of commercial motor vehicles



Motor-truck caravans are a practicable means of long-distance transport under emergency conditions

Long-Distance Trucking Justified in Emergencies

EXPERTS assert that industry in the United States has outgrown the whole system of rail transportation until the recent setback It will be years they said before the existing railway equipment can be restored to full efficiency and the extension of facilities necessary for the rails to catch up to the normal demands of business can be accomplished During the acute shortage of cars which existed last year business everywhere with its customary resourcefulness sought relief elsewhere Cut off at the round house it turned to the garage Inter city shipping by truck which under ordinary circumstances is included in the short haul category was commonplace and as ordinary as the motorization of hauling and delivery within the city

As the demand grew distances became longer and longer until the 1000 mile mark had been passed in numerous instances. Now the experienced truck maker and operator knows that under normal conditions there is no economy in truck hauls of such distances Hence he would not recommend them except in cases of great urgency However many emergencies have come up in the past which sent motor trucks over the roads on long trips The cost of these ventures was high but shipper and consignee alike considered the expenditure an ultimate economy We will point out a typical case

In order to keep its factory running a knitting mill in Delavan Wis. had to have yarn freight embargoes notwithstanding, from an Attleboro Mass plant of dyers and bleachers A 5-ton truck of standard make was called into service. With a cargo of worsted yarns valued at nearly $35 000 the truck set out on a scheduled round trip of 2 400 miles The contract price for the trip was $2888 25 or approximately $2 40 per mile one way—$1 20 per mile for the entire route. The emergency was met promptly

Similar situations have been met in other parts of the country and raise the question whether such use of trucks though involving increased expense was not an ultimate economy Suppose delayed shipments of raw material had been allowed to force suspension of production with a consequent loss of time for employes Very shortly lost time and decreased production would have proven much more costly than the emergency use of trucks for long hauling of needed raw materials Less tangible but none the less real was the danger of weakened prestige by failure promptly to fill certain orders a danger that proved to be the deciding factor in the decision of certain firms to use trucks

Many Factors in Farm Haulage

HAULING farm produce to market in motor trucks represents no means of the successful solution of the short haul one of the most difficult problems which confronts the transportation expert The failure of railroads to keep pace with the expansion of the short haul business the development of the producing areas adjoining the larger cities in proportion to the production demands asked of them and the upbuilding of the motor truck manufacturing activities have popularized this method of moving farm produce

Rural freight is hauled by the farmer who owns a truck and handles his personal marketing as well as that of his neighbor by motor by the local truck operators who haul farm produce as a business by the local automobile or truck agencies that operate transportation trucks as a side line by the city transfer company which also engages in rural hauling and by the large corporation which operates a fleet of trucks over a wide range of territory Naturally there is a similarly wide range in the methods of doing business.

Farm to-farm collection of freight is practiced on short rural routes where comparatively few stops are ordinarily made Such collection is costly both in time and gasoline and hence necessitates higher rates The cross-roads collection system is popular also the shippers centralizing their produce at certain points where it can be loaded on the trucks

Left Carrying boxes of garden truck to market *Right* 1½-ton trucks used by a dairy for collecting milk

Valuable service is performed for the farmer by trucks of his own or other ownership

The central assembling method where the shippers concentrate their freight at one point or where a lighter auxiliary truck collects and delivers it possesses many efficient features

There are many different systems of computing rates and charges for hauling There are several factors which should be considered in the establishment of rates in any district The value and the fragility of the load bear a direct relationship to the rate that should be charged The length of the haul naturally is a prime consideration Road conditions directly affect operating costs and hence must also be considered in establishing rates. The perishability and bulk of the load must be taken into consideration Where complete delivery is made from the door of the shipper to the door of the consignee this must be considered in fixing the rate

College Girls Tour East in Truck to Raise Funds

SEVEN Simmons College girls have cruised the country this past Summer on a unique venture The $2 000 000 endowment fund which their Alma Mater is out to raise is considerably richer by virtue of their efforts and enterprise Having mapped out an itinerary designed to take them daily to new places where people congregate—to Summer resorts carnivals and fairs—the seven girls chartered a 2 ton truck at Boston and embarked From the well stocked truck the Simmons seven sold creations of their own skill and originality and a conglomerate stock it was A partial inventory would reveal confections and cloth hats silver and furniture polish made at the college soap woolen and knit goods not to mention the famous Sally Simmons dolls

Truck used by college girls in cruise to help the endowment fund

The Heavens in January

Some New Observations Upon a Stellar Object of Old Interest

By Professor Henry Norris Russell, Ph.D

THE most interesting astronomical news of the past month relates to stellar matters. We may begin with a new chapter in a long and interesting history—that of Tau Coronæ Borealis, the new star of 1866. This object blazed out suddenly, of the second magnitude, on May 12th of that year, remained at maximum for only a day or two, and sank out of reach of the naked eye within a few weeks. As soon as its exact position had been determined, it was found that it was identical with a telescopic star, of the ninth magnitude or a little fainter, which had been observed years before by Argelander and listed in his great "Durchmusterung" catalog. This afforded the first evidence that these so-called "new stars" were not really newly formed bodies, but merely variable stars, previously existing, which had increased suddenly and enormously in brightness—a conclusion since confirmed in the cases of several other novae. This star, too, was the first nova to be subjected to examination by the spectroscope, which had just come into use in astronomy. Huggins detected in its spectrum the strong bright lines of hydrogen which are characteristic of the type, and from his drawings it appears that the spectrum was then very like that of more recent novae just after maximum. Within a few months the star had faded to about its original brightness, and it was almost forgotten by observers for half a century.

When half a dozen other novae had subsequently appeared and been studied it was seen that this one was fairly typical, except in a few particulars. Unlike all the rest, which lay close to the Milky Way, it was forty degrees from the latter, and it was brighter before the outburst than any other temporary star yet recorded. Moreover, the paroxysm of brightness was unusually short-lived, enduring but a few months where other stars often have required years to return to their original states.

The only recorded observation of late years was by Miss Cannon of Harvard, who classified its spectrum as of the K type. Now most novae on fading exhibit a spectrum containing bright lines much resembling those of the "early" (or probably hot) stars of class O, and not at all like the "late" (cool) stars of class K. It therefore occurred independently to Dr Lundmark at the Lick Observatory, and to Dr Adams and the writer at Mount Wilson to photograph its spectrum with powerful instruments.

A Surprising Spectrum

The two observers agree perfectly in their findings, which are certainly remarkable. The spectrum is of an advanced M type—indicating about the lowest surface temperature which prevails among the stars—but is rendered unique by the presence of bright lines, not only of hydrogen, which would not be remarkable, but likewise of helium—and an advanced line of helium at that (λ 4684 on the ordinarily used scale), which requires for its excitation about as violent a degree of stimulus as any known spectral line.

Unexpected as these findings were, they do not appear inexplicable. There is very good reason to believe that the catastrophe which causes the outburst of a nova, whatever it may be, affects only the surface of the star, and that much of the disturbed material is actually ejected into space—as is indicated by the extraordinary expanding nebula observed around Nova Aquilae. The rest of the star, comprising probably almost the whole of its original mass, gradually reverts to something more or less like its original state before the disturbance. Now in the case of Tau Coronae the outburst was apparently less violent than usual—as is indicated by the rapidity with which the light decreased. Hence it is possible that fifty-five years later the star may have settled down to its original condition as a red star of low temperature. The bright lines of hydrogen and helium, on this hypothesis, may be attributed to the remains of the ejected nebulous matter—though it should be noted that the well-known nebular lines in the green are absent.

Stars of class M appear always to be either giants, much brighter than the sun, or dwarfs, much fainter. We may hope that Dr Adams will be able to tell definitely from his spectra to which of these classes Tau Coronae belongs at present. It seems improbable that it is a dwarf, for then it would be very near us among the stars (twenty light-years or so), which does not agree with the absence of any considerable proper motion. If, on the other hand, it is a giant, it is now probably somewhere between ten and fifty times as bright as the sun. During the great outburst it was a thousand times brighter—which is indeed an enormous luminosity, though there is some evidence that Nova Aquilae may have been as bright. The whole affair illustrates strikingly what beautiful opportunities for discovery surround the observers with great telescopes. Adams' exposures on the star lasted only about three hours, Lundmark, with a smaller instrument, required the more heroic interval of some fourteen hours, distributed over successive nights. But even so, the game is well worth the candle.

A second interesting report comes from the University of Illinois, where Professor Stebbins has just completed one of those precise and admirably finished studies upon eclipsing variable stars for which he is justly famed. As in the rest of his recent work, he used the photoelectric photometer an instrument of extreme precision, but demanding great manipulative skill. The object of his study was the star 1H Cassiopeiae (that is, No 1 in Heis' list of the stars of this constellation), which is a star of the fifth magnitude, in the western part of the constellation, and may be found by carrying a line from Gamma Cassiopeiae through Beta, and extending it as far again, bending slightly to the left. It was discovered to be a spectroscopic binary in 1908, and was later found to have a period of slightly more than six days.

A New Eclipsing Binary

Among stars of this sort, which are known to have faint companions revolving fairly close to them, a considerable proportion are likely to have their orbits turned so nearly edgewise to us as to produce eclipses, and the present case is one in which Professor Stebbins' examination for such phenomena has been rewarded. Two well-marked eclipses occur during the period—well marked, that is to say, when the observations are as precise as those of Stebbins. The loss of light is only eleven hundredths of a magnitude at one eclipse, and three hundredths at the other, and would be quite imperceptible to the ordinary eye. The deeper eclipse lasts two hours, and the other about twelve—the difference arising from the eccentricity of the orbit.

From this light-curve Stebbins shows that the principal star has a smaller companion, of one-third its diameter, and only one-thirtieth as bright. When this passes in front of the primary it produces an annular eclipse, cutting off eleven per cent of the light. When the companion is hidden behind the larger star the loss is only three per cent of the total light. This is the first time that the faint companion in an eclipsing pair has been found to be both smaller and duller in surface brightness than its primary. There are probably plenty of such systems in space, but a moment's consideration shows that in such a case the loss of light during eclipses must be small regardless of which star it be that is eclipsed, so that it is not likely to be detected except when, as in this case, something else tells us what stars to observe.

Even in this case, the companion is far from being a "dark star." Stebbins shows that it is probable the brighter star is about six times the sun's diameter, and the fainter one twice as large as the sun. The larger body is about one twenty fifth as dense as the sun, and the smaller one seven times denser. We can only guess roughly the distance of the star from its proper motion, but this indicates a value of some 500 light years. This would make the larger star about 300 times as bright as the sun. The "dark" companion would then be ten times brighter than the sun—and larger and hotter to boot—so that if the sun were its satellite, it would in turn be in danger of being called a "dark body."

At 11 o'clock: Jan. 7
At 10½ o'clock: Jan. 14.
At 10 o'clock: Jan 22.

At 9 o'clock: Feb. 6.
At 8½ o'clock: Feb. 14
At 8 o'clock: Feb 21

At 9½ o'clock: Jan 29.

NIGHT SKY: JANUARY AND FEBRUARY

The Heavens

Turning to our star map, we find the familiar constellations in their usual winter places—Orion on the meridian, Canis Major below, Canis Minor high in the southeast, Auriga Taurus and Gemini grouped around the zenith, Hydra and Leo in the east, Ursa Major in the northeast Ursa Minor and Draco in the north, Cassiopeia, Perseus and Andromeda in the northwest, and Cetus and Eridanus in the southwest.

The Planets

Mercury is an evening star, but is not well visible until the latter part of the month. At elongation, on the 29th, he is 18 degrees from the sun, and sets at 6.40 P M. He is then in Aquarius, far from any bright stars, and being himself brighter than Capella, should be conspicuous.

Venus is a morning star, but is getting very near the sun so that she is practically invisible. Mars, on the contrary, is coming out toward quadrature and rises a little before 2 A. M in the middle of the month.

Jupiter is in western quadrature on the 8th, and rises just after midnight, while Saturn, ten degrees to the westward, comes up some forty minutes earlier. Uranus is an evening star, too near the sun to be observable, while Neptune, in Cancer, is approaching opposition and crosses the meridian at 1.30 A. M in the middle of the month.

The moon is in the first quarter at 5 A. M on the 6th, full at 10 A M on the 13th, in her last quarter at 1 A M on the 20th, and new at 7 P M on the 27th. She is nearest the earth on the 14th, and furthest away on the second and again on the 30th. During the month she passes by Uranus on the 3rd Neptune on the 14th, Saturn on the 18th, Jupiter on the 19th, Mars early on the morning of the 21st, Venus on the 27th, Mercury on the 29th, and Uranus again on the 30th. The conjunctions with Jupiter and Mars are close, and should be worth looking at if one wakes early enough.

Princeton University Observatory
November 4th, 1921

The Mechanism of the Psychic

Indications of an Unformulated Force, and What We May Hope to Make of Them

By Hereward Carrington, Ph.D.

EVERY age sees a new science—a whole body of new phenomena and the principles that govern them, developed where we had not even been conscious of a void in our knowledge. Once it was electricity, again it was psychology Now it is the field to which the name of psychic has been given We have no reference to the question of personal survival or that of communication with those alleged to have survived But there is a growing fund of authenticated phenomena which can be explained by no natural law yet formulated When all cases of fraud and misinterpretation are ruled out, there remains a residuum of manifestations which can best be taken to indicate the existence of an unidentified force We may hope that the science of tomorrow will tell us what this force is, and give us control over it

Substantially thus we spoke in our 75th anniversary number fifteen months ago We have since been searching for some authority who could formulate the problem, describe what has already been accomplished, and outline the possibilities of the future in a sane manner In Dr Carrington we have such a man—one who for years has been in close touch with the respectable side of the psychic world, and who is sufficiently acquainted with the other side to know where to steer to avoid it Naturally in any subject that consists so largely of forecast and speculation he must speak for himself and not for the SCIENTIFIC AMERICAN *It is however a pleasure to put his remarks before our readers He plans to say more in a future issue* —THE EDITOR

THE past century has been eminently scientific In physics chemistry biology astronomy—the physical sciences generally—vast progress has been made But the further science progresses the nearer do its conclusions tally with those for long taught by the so-called occult And whereas science has done much to discover the grosser energies of the body it has done very little toward discovering its finer and more subtle forces—those with which we apparently deal in psychic investigations and upon the operation of which psychic phenomena depend Here, I believe is the field of the future

Take for example, the recent discovery by Dr Charles Russ of the energy which is said to radiate from the human eye A delicate solenoid of mica covered with strips of aluminium is suspended in a glass vessel to the outside of which are affixed metal plates electrically charged When the gaze is focussed intently upon one end of the cylinder it moves away from the eye when the gaze is directed toward the other end it moves toward the eye and when the center of the cylinder is gazed at it remains stationary All normal causes seem to have been carefully eliminated and so far as I know these results have never been explained

Here we have an example of what I mean by the subtle energies of the body This experiment is one of the first of this nature more or less admitted by orthodox scientists and if accepted, will constitute an opening wedge for the admission of further phenomena of the kind All of which recalls the famous remark of Professor William James that whenever the mystics and the scientists have had a dispute as to certain phenomena the mystics have nearly always been right as to the *facts themselves* and the scientists have usually been right as to their *interpretation* But interpretation is a secondary matter Let us establish the facts first of all and their interpretation will follow in due course

This question of a vital energy of some sort radiating from the human body throws an interesting light upon other problems For if such an externalization takes place it is possible that inanimate matter may be enabled, in some way to receive and to store up this energy Dr Hodgson through his experiments with Mrs Piper became convinced that objects handled by the medium did in fact stimulate phenomena and insure at times a new flood of supernormal information Whatever the explanation may be the facts are undoubted, as I also observed in my own sittings with Mrs Piper

In haunted houses again a "psychic atmosphere seems to be present and we know that in mediumistic séances, a definite charging up process seems to take place within the cabinet and from this cabinet radiate the phenomena Other things being equal a small room or a small cabinet is better than a larger one which is what we should expect if an energy were being stored up for future use

Take again the question of the human aura We can artificially create an electric aura around living bodies by means of high frequency currents but this is quite a different thing from the natural aura said to exist and observed by Kilner and others by means of chemical screens Kilner himself believes that this is an ultra violet phenomenon and in his latest book has published a number of interesting experiments as to the effects upon the aura of electricity magnetism various chemicals etc Here again is a whole field for study and research relating to the subtle energies of the body upon which, however much light will be thrown by proof of the bodily radiations, or exteriorized energy, before referred to

And here, of course, we are reminded of the phenomena of materialization—that incredible phenomenon which has nevertheless been so well attested in the case of Eusapia Palladino, and other mediums in the past and in the presence of Eva C today These phenomena whatever their ultimate explanation may prove to be certainly depend upon the emergence of a form of vital energy from the body of the medium Into explanations I do not propose to enter I wish only to emphasize that all these phenomena, and their subsequent interpretations depend upon the central fact of the externalization beyond the periphery of the body, of some form of vital energy

All this has been pointed out in the past by competent investigators. Now however I wish to lay out one or two theoretical speculations which are I believe, more or less novel in character The first point is the apparent connection between the normal, physical energies of the body (and particularly the sexual energies) and certain psychic manifestations

Mr Podmore in his analysis of a number of "poltergeist cases pointed out that the great majority of them occur in the presence of a young boy or girl between twelve and sixteen years of age. He endeavored to prove that trickery would account for the majority of these cases if not for all of them, and assumed that the spirit of mischief, often present in children at that age, inspired them to produce the manifestations Undoubtedly this was the motive in certain cases. But in view of newer cases quite unexplained and of psycho-pathological researches into mediumship and hysteria, it now seems certain that many cases of this character are genuine and that supernormal phenomena *do* occur in the presence of certain peculiarly endowed individuals

These 'poltergeist phenomena are usually spontaneous in character They even continue to occur in spite of the opposition of the subject, as in the case of Angelique Cottin about the middle of the last century An energy seems to be radiated from the body in such cases which induces these phenomena and it will be observed that this takes place at about the age of puberty, when the sexual energies are blossoming into maturity within the body It would almost seem as though these energies instead of taking their normal course were somehow turned into another channel, and externalized beyond the limits of the body

There may, therefore be a definite connection between sex and psychic phenomena, and this seems to be borne out by several analogies. Recent physiological researches as to the activities of the ductless glands, and particularly the sex glands, have shown the enormous influence of these glands upon the physical and even upon the psychic life The observations made in the cases of Kathleen Goligher and Eva C show that the 'plasma which is materialized frequently issues from the genitals. The clinical observations of Lombroso Morselli and others upon Eusapia Palladino brought to light many recognized sexual stigmata. And all ecstatic religious rites show the connection between sexual energies and the ecstatic states, just as we find instances of sublimation' in modern Freudian psycho-analysis

And speaking of Freud—it has often struck me as remarkable that more experiments have not been tried in crystal gazing automatic writing, etc., with physical mediums, with a view to ascertaining possible subconscious associations A detailed psychological study of the patient's utterances in delirium has never been undertaken; and assuredly the psychology of insanity is yet in its infancy! Nevertheless the study of all these conditions is of the utmost importance, since they throw light upon the psychology of mediumship; and, assuming for the moment the spiritistic hypothesis to be true, upon the mental state of the communicator while sending messages through the medium.

It is possible, however, that we shall yet have to take a further step before we shall be in a position to understand all this fully I have, throughout, been speaking of the subconscious mind. Is it not possible that, in addition to this, and the conscious mind, there may also be a *superconscious*, that it is this mind which is active in certain ecstatic and trance states, that it is through this mind that all supernormal phenomena operate? It is possible that telepathy and other supernormal phenomena take place through this realm; that there is a "mentiferous ether," as some writers have suggested, which carries telepathic waves. The discovery of this ether, or of the actual mechanism of thought-transference, would assuredly be a profoundly important one for psychical science!

Just here, perhaps, I may be permitted to offer a suggestion, based on analogy with the "carrier waves sometimes employed in radio It would certainly be interesting to try experiments in telepathy in, say, a high-tension electric field, through which electric waves of definite frequency are passing which might act as carrier waves. Under these circumstances it is conceivable that telepathic waves, if such exist, might be reinforced and rendered perceptible by some delicate recording apparatus. At least the experiment should be tried. Experiments should also be tried it seems to me, while both sender and percipient were breathing in unison or when certain chords were struck on the piano Though all these tests might lead to no definite results, it would be at any rate interesting to try them, and so far as I know they have never been tried.

This idea—that telepathy must be in some sense dynamic in character—throws light upon a variety of problems thought photography, telekinesis, the operation of certain instruments. If mind is thus active and the vital energies are also capable of acting beyond the periphery of the body we may derive from these facts the general conclusion that, in all its activities, *life is dynamic*

I would here emphasize one important point which has been to some extent overlooked the rapid and remarkable growth of instrumental tests. How simple and relatively primitive were the tests undertaken by Professor Hare and Sir William Crookes compared with the complicated and beautiful apparatus which has been devised and is employed in psychic investigation today! We can trace the gradual evolution of such laboratory methods, from the first tests made by Hare and Crookes, to those employed by Bottazzi Lombroso, Imoda, and others with Eusapia Palladino to those conducted by the General Psychological Institute, of Paris, with the same medium, to Dr Coover's kymograph tests with "Mrs. Kay," to Dr Crawford's ingenious tests with Miss Goligher; to Dr von Schrenck-Notzing's photographic and microscopic tests with Eva C, to the beautiful apparatus perfected by Dr Grunewald. This shows an evolution of scientific laboratory methods comparable to that of any other science.

We in America are endeavoring to push still further this line of investigation. "The American Psychical Institute and Laboratory" has been founded in New York, for the purpose of investigating certain branches of psychic phenomena, by instrumental means in a properly equipped laboratory. We have already secured the names of a number of eminent men for our Council, and it is my hope that we may be enabled to secure many more, and to justify their support and adhesion by our work, which we shall endeavor to make sound and scientific.

We began, very naturally, by acquiring or building a

(Continued on page [illegible])

Inventions New and Interesting

A Department Devoted to Pioneer Work in the Arts

The gearless brake that pulls like a geared one

Increased Hand-Brake Efficiency

THE simple staff hand brake in use on passenger and freight trains is largely a survival from the day of lighter loads and lower speeds. Under present conditions it is often entirely inadequate to meet the loads put upon it. While geared brakes meet the need for greater power and a number of these are in use, objections based upon initial cost, weight, size, or failure to release satisfactorily have prevented their general installation. An interesting design of brake staff has just been put forward, giving all the advantages of the geared brake with none of its disadvantages, according to the manufacturer.

For any given pull on the brake handle of a staff brake the tension on the chain varies inversely as the distance from the center of the chain, in winding to the center of the staff. The brake which we illustrate has a winding channel for the chain to run in, and the shank around which this channel passes tapers toward the bottom and at the same time runs out of the true center line of the upper portion. The result is to give less tension and rapid take-up of the slack in the chain at the start of the braking operation with slower take-up and greater braking tension toward the end where it is useful. The ultimate result is that operating with the ease of a gearless brake the efficiency is that of a geared brake with ratio of three to one.

A Grease-Cup Wrench

SCREWING down grease-cups by hand is a dirty job as every driver knows. And there is little satisfaction in trying to substitute for the dirty finger any wrench or pliers of conventional design. It always turns out that the instrument that will grip the circular rim of the grease-cup without slipping has its handle attached to the business end in such a way that the leverage is not at the proper angle for this use. But now we are offered a modification of the socket wrench, designed especially for the grease-cup job and the picture shown herewith makes it plain that at last we may hope to keep our cars greased and our fingers clean at the same time.

A modification of the socket wrench designed for turning down grease cups

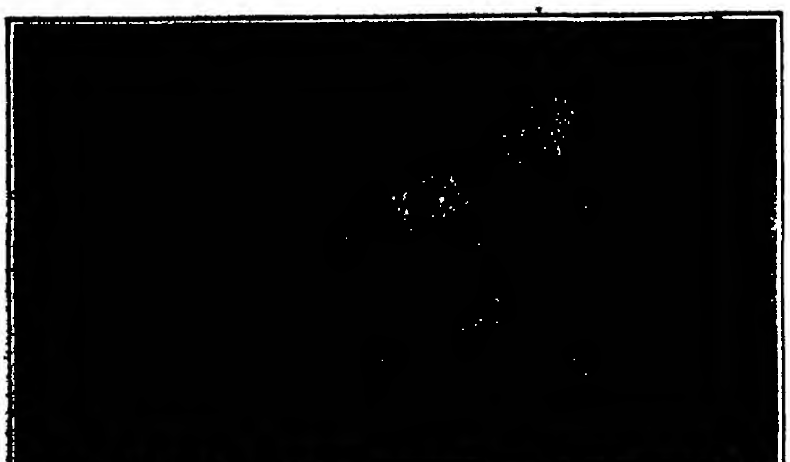
Making an Addresser of the Typewriter

ADDRESSING envelopes on the typewriter is something that is always avoided when there is a large number of envelopes to deal with and any possible way of addressing them by other means. It is not that the actual work of typing on the envelope is slow or unsatisfactory in its results, but the placing of the envelope in the machine and its removal are operations that take time. We can afford to put a sheet in and take it out again in connection with the writing of a letter of reasonable length, but when it comes to the mere typing of name and address the non-productive end of the job assumes too large proportions in comparison with the time which the operator is able to devote to actual typing.

Large batches of envelopes however can not always be addressed from a mailing list prepared in advance and hence the various addressing machines which one would prefer to the typewriter are not always susceptible of use. It is with this situation in mind that a Cleveland manufacturer has put out a rapid fire feeder that handles the envelopes for the typewriter and reduces the operator's efforts almost entirely to the manipulation of the keyboard. The appearance of the new device which can easily be attached to any standard model typewriter is shown by our photograph. In operation a single motion of the operating lever puts into effect the following operations.

The envelope is brought down and placed in the carriage in the exact position for the first stroke of the keys. The carriage is moved to proper position for this stroke. The list holder moves the list of names upward keeping the next name to be addressed constantly before the operator. A counting device attached to the feeder registers so that at all times the exact number of envelopes addressed is known. The previously addressed envelope is ejected as the one to be addressed is brought into position so that the carriage is never empty.

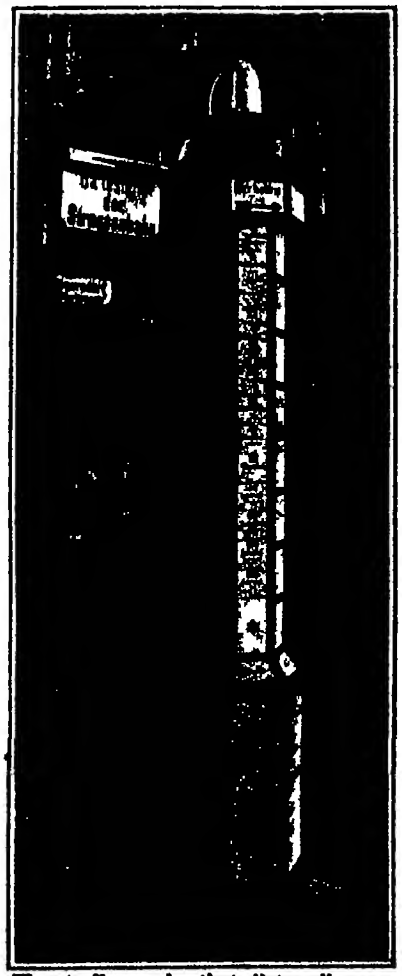
The apparatus is fitted for use both with a continuous list and with cards. The list holder operates entirely automatically as indicated above. With the card holder, the cards must be removed from front to rear by hand as they are addressed; this operation consumes no more time than is necessary for the shifting of envelopes, hence results in no loss of time at all and leaves the card file at the end in the same order as at the beginning. The card holder is easily adjusted to fit any standard size of card and has a capacity of about 125 cards after which it must be replenished from the file. The counter can be permitted to run to the end of the job, or can be set back to 1 at any moment.



The quick and easy attachment that converts the ordinary typewriter into a speedy addressing machine

The "Haltstellenanzeiger"

MOST of us have had the distressing experience of standing on a corner of the main street of an unfamiliar town where apparently all the car lines in the county ran and of waiting, and waiting for the desired car eventually to learn that it runs through another street three blocks to the north. Or perhaps our troubles arose from a staggered stop system, where some lines stop at every corner, others at alternate corners only and the interurban expresses every half mile or so. In any event we shall recognize the instant and automatic solution in the trolley station pole illustrated herewith, which has been installed at Berlin's busy corners. All lines in the city are designated by numbers much like the several lines of the Fifth Avenue Bus Company in New York. These numbers do not replace altogether a fuller statement of destination etc. but they do make possible the identification of a car from a much greater distance than would be the case in their absence. And with the numbers on the cars and a complete list on the pole of all lines that stop there the stranger in town knows instantly whether he can get his car at this point or whether he must inquire. The stopping place indicator to translate the name of this device could find a place in many American cities. But if it were to be given this place we are sure that the spaces left for advertising placards would not show so many vacancies as the apparently more conservative Berlin merchants have allowed to remain unfilled.



The trolley pole that lists all cars stopping at this corner

Not a new stove: merely the latest deep-sea-diving outfit

The Washfountain

EVEN the fountain, that classic symbol of all that is ornamental, has now been converted to the uses of utility. An American manufacturer has recently put on the market a device which he calls a "washfountain." It may be used wherever large wash-rooms are necessary, in factories, schools, public buildings, hotels and railway stations—in fact, every public or industrial lavatory.

The saving in space is considerable as compared with the old-fashioned wash bowls. It has been shown that bowls for 24 people require a minimum of 91 square feet floor space, while the washfountain accommodates an equal number in comfort using only 64 feet. This economy naturally increases with each succeeding installation.

The fountains are manufactured in two sizes—a 54-inch basin to accommodate 12 people, or a smaller, 32 inch, where six people may wash at one time. Due to the circular construction of the fountain there is plenty of "elbow room" for the comfort of the users.

Considerable economy is effected in the amount of water consumed. The washfountain built to accommodate 12 people for instance, uses no more water than the amount piped for one wash bowl. This is accomplished by converting the flow into a fine stream—just as effective. Hot water costs are also reduced, since the water may be heated at any desired temperature, evenly.

Soap is supplied to the washfountain by a device which is part of its design. Either liquid containers of sturdy glass and nickel or receivers to hold cake soap may be specified. The flow of water is controlled either by a hand-valve or a foot-lever, as desired.

Drinking-fountain practice extended to the wash-room

Submarine Armor

THE effort to increase the vertical radius of action of the diver is one which we shall always have with us—the more so in view of the tantalizing fact that most of the sunken treasure of the late war is at a depth only moderately below the present limit of operations. For a good many years there has been no material technical advance in deep-sea-diving outfits. Each designer has to be sure, added or tried to add some further margin of safety, but all attacks upon the problem have followed substantially the same line. If we can but make a suit that will stand up under the pressure and keep the water out of its seams, it is obvious that we can go to any depth for which these requirements are still met. If in the bargain we can make a suit with joints that can be operated at such depth by the muscular power of a husky man, we shall be able to work there as well as go there.

The deep-sea-diving outfit illustrated herewith is not presented because of any claimed departure in fundamentals from its predecessors, but purely because of its fearful and wonderful appearance. Perhaps the nearest thing to actual novelty which it shows is the frank admission that direct work with the hands is not to be attempted, and its consequent provision of artificial hands, not sensitive to pressure. The ball-and-socket joints look, too, as though they might permit considerable motion without change of volume of water displaced thereby, obviating one of the great difficulties of deep-sea work—the fact that as soon as the diver once assumed the position in which his displacement is a minimum, further movement must be against the entire pressure developed by the water at the depth in question. More than one diver has found himself "frozen" in this position of minimum volume and unable to move out of it.

French machine for rolling cigarettes with one hand

A Machine for "Rolling Your Own"

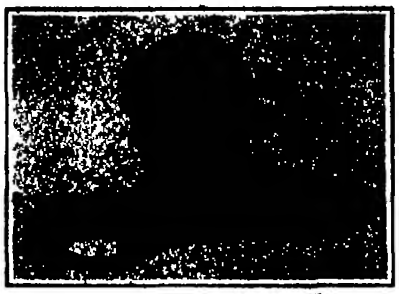
AMONG recent inventions few are more clever than the cigarette-rolling machine put out by M. de Louvencourt, of Paris. Referring to the illustration, the white band that extends clear across the apparatus from end to end is a strip of draftsman's tracing paper. This furnishes the background against which the rolling operation is carried on. A pinch of tobacco is laid upon this ground in the hollow at the right, the tobacco accommodating itself to the curve. French tobacco being stringy instead of finely cut, works best in this device. The handle is then swung up and over the top of the machine toward the left. The loose end of the tracing paper is picked up and bent over gradually, and at the appropriate moment a piece of cigarette paper is introduced. As the cigarette paper and the tobacco are rolled along by the handle, the former is looped double, with its end at just the psychological spot, so that continuation of the motion starts it rolling up on itself—with the tobacco inside all the time, of course. The completely rolled smoke is delivered at the left end of the "machine," and has but to be extricated from its tracing-paper entanglement, licked and sealed. The machine works admirably with the long, stringy tobacco prevalent in France. It is less efficient with our finer plug cut, but for the man who has but one hand and who has never been able to learn the trick of rolling his own with that hand it should still be a very happy solution of the problem.

A Carriage for the Perspiring Drummer

A BASS-DRUM carriage which will do away in parades and orchestras with the sight of the perspiring drummer with an enormous drum strapped around his neck, has now been perfected. On this new device a drummer can now easily rest his large, bulky and heavy bass-drum, and roll it along any distance without being interfered with in his playing.

The wheels of this new device are 28 inches high and are very durable, and the carriage is made to fit all sizes of large drums.—*By A. H. Kolbe.*

Lightening the drummer's load



The non-squirting orange peeler

Juiceless Orange Peeler

TO peel an orange so that the juice escapes the fingers is a trick that few lovers of the fruit can accomplish. Those of us who have eaten oranges in their native states are told that the most enjoyment and real flavor comes when we eat the orange by quarters.

A juiceless peel for oranges is now assured by the use of a new orange peeler. A groove is first cut around the center. After this is removed, the spoon end of the device is used to turn down the skin. It does so quickly and without letting any juice escape on the fingers.—*By M. M. Hunting.*

Artificial Daylight for the Movies

THE thousands of movie fans who marvel at the wonderful photography as hundreds of feet of film are displayed on the screen and who perhaps know from their personal experiences with a camera that sunlight is so highly essential to good pictures, will undoubtedly marvel still more when told that artificial illumination is used almost entirely in the making of films.

For years motion pictures were produced almost entirely in southern California because of the quality and duration of sunlight available. Although sunlight is the brightest possible light, it does not meet present-day requirements of the movie concerns. Within recent years methods of artificial illumination have been so greatly improved and developed that sunlight is being superseded by electric lighting. This form of illumination can be controlled and directed at will, a feature of no small importance.

With the sunlight no special effects, so essential to the motion picture in its present advanced stage of artistic development, could be obtained. Even on a clear day light values do not remain throughout the day at the same intensity. At noon perhaps the light is very bright, but as the day begins to wane about three or four o'clock in the afternoon, the photographic value of the light is very much lower. In the making of a film it may happen that part of a scene is filmed at noon, and because of some changes in scenes or need for new characters, there will be a delay of three or four hours before it can be completed. Under natural light the first part of the scene when screened would be very bright and clear, whereas the other part would be darker and less distinct, causing confusing effect to the spectator.

Thus the need for an even, unaltered light at all times of the day which can only be supplied by artificial means, and which is now being used almost entirely in American studios. There are several schemes for producing this constant illumination. One of the latest comes from the big factory and laboratory in Schenectady, and uses the new high-intensity studio light, which in external appearances resembles a searchlight. It can be used as a spot or flood light, much the same as the searchlight where the light rays are focused and projected in a small beam, or as a prime flat light to illuminate the entire setting or scene. This can be done by removing the glass mirror at the back, which focuses the light rays, and thus allowing a general spread of the light from that end of the projector. The light itself has a 24-inch mirror, its carbons are fed together electrically requiring practically no atten-

High-intensity motion-picture studio light that is fast replacing daylight in this industry

The latest drawing pen opens like a knife, so that any clotted ink may be easily removed

tion, and its entire operation is of the most simple nature. It is mounted on a base with rubber-tired wheels of a large diameter, making it easy to move about, and can be raised to an elevation of about 10 feet, where an overhead spotlight is desired. The entire device weighs less than 500 pounds.

This light, one of the most powerful adapted to the studio, is particularly useful where moonlight or sunlight coming through a window or the illumination of large settings is desired It is also valuable for back-lighting By focusing a spotlight on the back of the heads of the principals the images are caused to stand out from the background and the figures are more pronounced and thus a better depth is obtained. If this were not done the figures would go dead against the background, no matter how far they stood in the perspective. They are also used a great deal to counteract shadows caused by other lighting apparatus.

Even out of doors in the daylight there is use for artificial illumination. There are scenes, just as in ordinary photography, that are too dark even at midday to be taken without extra light. Then, too, there are times in the bright sunlight where artificial light is needed to counteract shadows caused by the sun or to light up faces of persons when their backs may be to the source of natural light To meet such situations a portable power plant has been perfected—an electric generating outfit mounted in a motor truck A gas engine drives an electric generator, which supplies sufficient power to operate the powerful lights, the same as used in the studio.

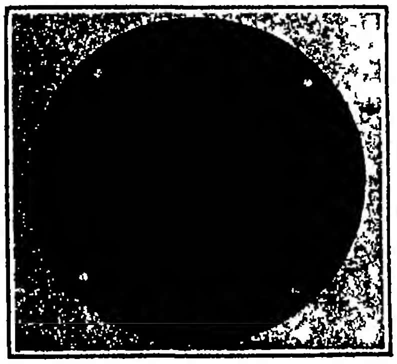
Testing Cylinder Variation

AN instrument that indicates easily and accurately the size and concentricity of a cylinder throughout its entire length is being manufactured by a Rhode Island firm In this device gage feelers project from the casing. These feelers are actuated by means of a cone cam, inside the casing, which is directly connected by a steel rod running through the tube to a rack and spur movement that operates the dial hand. A button projecting through the knurled sleeve is attached to the steel rod. By pushing this button down the cone cam is likewise lowered and the feelers are permitted to recede sufficiently to be inserted in the cylinder Pressure on the button is withdrawn when the feelers are inside the bore, and they are automatically released against the cylinder walls.

Provision has been made for building up one of the three feelers so that with a set of extensions measurements can be taken of any diameter between 2½ inches and 6½ inches. Nipples are made in different sizes to cover any fractional part of an inch. The nipples fit interchangeably into the extension rods, which vary in length by 1-inch steps and supported by thread bushings. The gage dial is graduated by .001 inch with sufficient space between calibrations to allow variations of .0005 inch to be easily read. The dial is always in plain sight and can be set to any position with reference to the hand by turning a knurled bezel. A master is used, at times, to furnish a means for setting the gage accurately to a standard diameter

In use, the instrument is rocked from side to side and the smallest plus or the largest minus reading of the gage indicates the actual error at the point of application

A model is also constructed for measuring cylinders of a standard diameter



An altitude indicator that may clear the carburetor of unjust suspicion

It differs from the other model in having three solid feelers of equal length centrally located A centralizer, to hold the instrument in the center of the cylinder, has a three-point bearing To compensate for slight variations from the standard, the bearing surface of one of the three centralizer lugs is cut away and a flat copper spring is attached to it The collar or depth stop is held by a set screw and can be placed on the body to conform with the depth of the cylinder to be measured and thus prevents the feelers from being thrust beyond the bottom of the hole.—*By Allen P Child.*

The Art of Using a Drafting Pen

ANYONE who has an inventive turn of mind has occasion now and then to make a drawing of some invention or device which he *may afterward wish to* have constructed, and yet the beginner in such efforts seems to experience great difficulty in the use of the drawing pen. Even persons who have practiced for a considerable time are often unable to make lines of uniform thickness and appearance

Troubles of such a nature usually result from imperfect flow of the ink As the pen points are but a little way apart the ink will cease to flow regularly as soon as it hardens or thickens to the least extent. Drawing ink is made to dry quickly to prevent blotting and smearing during the frequent shifting of the triangles or straight-edge. That is the reason that wiping the pen and cleaning it thoroughly is necessary at frequent intervals.

The beginner does not appreciate this necessity for keeping the pen points free from clotted ink, and consequently he wonders at his frequent failures and becomes discouraged with his work To make the cleansing process easier some of the latest types of ruling pens open and shut like a knife, so that a cloth can be inserted between the points without any difficulty The type shown in the figure is of this kind, and it is provided also with marks on the set screw for adjusting accurately the distance apart of the points and regulating the thickness of the lines.—*By H C Ridgeley*

For the Mountaineering Motorist

FOR the tourist or those who live in mountain country comes the automobile altimeter It is a compact little instrument which sets into the dash of your car and tells you exactly what height you are above sea level If your engine starts choking or sputtering, when your car is equipped with one of these altimeters, you can easily tell whether the carbureter or the altitude is to blame.—*By F G Jopp*

The New Rumpler Car

THE most radical departure from existing methods of motor-car design shown at the Berlin exhibition no doubt is to be found in the Rumpler *"Drop" Car*, a striking adaptation of the experience gained in the construction of aircraft The three innovations embodied are. First, the body as well as the chassis is drop-shaped, that is, has been given the shape corresponding to a minimum air resistance, as in the case of a falling drop Secondly, the motor is arranged in the rear part of the car and is, with the gear, clutch and rear axle, combined in a compact system described as "motor-gear-axle" The third, and perhaps most important, feature is the use of a double-sectioned rear wheel axle, oscillating round the center of the car and thus reducing to an unprecedented minimum the weight of masses not hung up in springs.

Clean sleeves as well as clean hands follow the use of this glove

The cruising garage—a friend in need on California's main highway

"Here Comes Help!"

WHEN you're miles from a garage and your car refuses to budge another inch, and maybe your gasoline is all gone, or a broken axle or a parted universal joint or a smashed gear-box or a differential that won t differentiate seems to have condemned you to an all-night stand, wouldn't you smile if you saw a sign loom up in the distance, "Here Comes Help"?

Patrolling the highway, El Camino Real, which extends from San Francisco to Los Angeles, is a completely fitted-up wrecking car with this comforting sign on it, and its owner is kept pretty busy on Sundays and holidays, as the traffic on this highway is very heavy

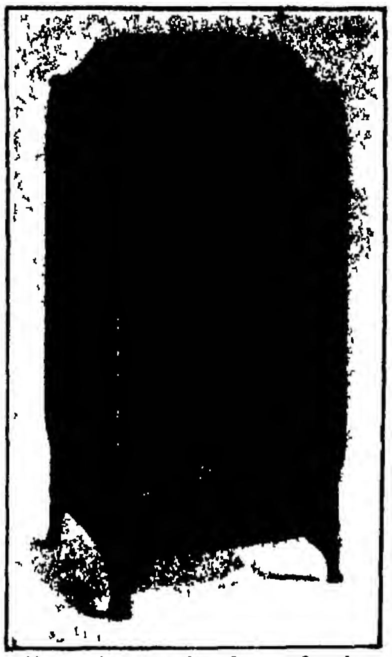
Metallurgical Examination of a Broken Crank-shaft

A BROKEN crank shaft from a 10-ton ammonia refrigeration machine was submitted to the Bureau of Standards for examination by one of the other Government departments. The material proved porous and showed evidence of not having received sufficient reduction in forging The break which occurred was in the nature of a fatigue failure and had its origin in the angle between one of the throws and the bearing A defect at this point had been filled in previously with arc fused metal Such a procedure would not necessarily lead to failure had the defect been located elsewhere, but at the point in question the stresses are much higher than at other points on the shaft, and the break once started would be propagated rapidly owing to the unsoundness of the steel.

Long Gloves Save Sleeves

A LONG WRISTED glove for the use of automobile owners when making minor repairs about a car is one of the new accessories seen in automobile row shops. This particular glove is made of washable material, and has a strap and buckle at the top which aid in keeping the long wrist high on the arm Protection to sleeves is provided with a consequent reduction in laundry and cleaner's bills. The long wristed glove is not only for the use of car owners, but can be used to advantage about the house, as for use in stoking the furnace

For obvious reasons we show lying on its side this instrument for rapidly measuring the small variations found in automobile cylinders. The dial is really the top of the apparatus



Not a phonograph, a heater for the parlor

Parlor Furnace That Looks Like Phonograph

A CLEVER designer has developed a heater which many people who object to a stove in the parlor will welcome It has all of the appearance of a cabinet phonograph yet it works as a pipeless furnace It is, however made of steel plates, but they are finished to look like mahogany, grained like rare old wood, polished to the fine luster of expensive furniture

Starting with the name which ends with a "rola," the resemblance to a phonograph is carried out in the design of the front, the sides, top and supporting legs Ornamentation such as one finds on a wooden cabinet is used

This affair is in reality a pipeless furnace which will heat from three to six connecting rooms. It will burn any kind of coal and holds fire for fifty hours

It is claimed for this heater that housewives will find it more easily kept clean, as the polished mahogany finish requires but to be rubbed with a cloth just as furniture is handled—By *Charles A Goddard*

High Temperature and Concrete

FIRES where temperatures are reached sufficiently high to cause the fusion of metal window frames, brick and concrete are rare Therefore the high temperature fire which took place last year in the chemical works of the Barrett Manufacturing Company near Philadelphia, is of special interest

The building destroyed was a two-story structure used for the cooling of naphthalene, which was stored in flat tanks, some resting directly on the beams of the upper story and others at intermediate levels on both stories. The whole structure was of reinforced concrete with the exception of two unprotected steel roofs, and it should be noted that the upper floor was constituted by the beams and the naphthalene tanks, no flooring, in the ordinary acceptation of the term, having been provided. The fire started in one of two naphthalene tanks outside the building, and the flames rapidly spread to the interior tanks, the building having been gutted within 45 minutes after the initial outbreak. It appears that the steel roofing collapsed almost immediately after the fire started, bringing down the second floor Naturally, the heat was most intense nearest the exterior tank, and on the side facing the latter some of the concrete was fused wired glass was melted, and steel window mullions melted and ran down the frames in places.

From a consideration of all the data available the following conclusions have been drawn the spalling of the concrete was largely due to the use of coarse aggregate containing a large percentage of quartz, the adoption of square columns accentuated the amount of spalling the structural part of concrete should have a protective coating, the thickness adopted being governed by the temperature to which the construction may be subjected the sprinkler installation was rendered inefficient by breakage of the electrical circuit operating the pumps. Finally, the engineers of the owners are said to be of opinion that there is no material more suitable than reinforced concrete for use under conditions such as those prevailing in the building destroyed, and that this material should be employed in the work of reconstruction.

The auxiliary lamps (see arrow) follow the wheels on every turn

Sewing Machine for Furriers

A PECULIARLY sensitive machine for sewing furs is making the life of the furrier easier As it is highly undesirable that stitches should anywhere appear on the outer or fur side of a

The side-stepping sewing machine for furriers

garment, a machine of unusual construction is necessary The needle does not sew straight down and up in the customary way Instead there is a sidewise motion practically parallel with the surface of the material—By *William Walsh*

Lamps That Turn with the Wheels

AMONG the things that every driver knows about his headlights is the fact that they don't always shine where he wants them Particularly in making a sharp turn the wheels often get ahead of the lights, and one is in doubt as to just where the car is headed. The auxiliary lights illustrated herewith are mounted so that they swing with the wheels, and are therefore bound to throw their beams as far around the corner as convenience could possibly require Incidentally they are right down on the road, where the light is wanted.—*By F. G Jopp.*

Home-Made Typewriter Ribbons

THIS mechanism takes in a piece of raw white tape and turns it out a finished typewriter ribbon ready to be inserted in a machine. The tape unrolls from the flat holder or cylinder at the right around a series of smaller cylinders or holders, as the crank is turned by hand. At the bottom of the middle center is a well which inks the tape in the process.

The Torrent Dishwasher

THE housewife who insists that her kitchen must be entirely cleared of equipment not in actual use, and she who cooks and washes dishes in a kitchenette, will both welcome the latest dishwasher It fits into the cupboard out of the way when it is not being used.

The new machine washes dishes perfectly because it is hand-directed, like a vacuum cleaner, the 40-pound-pressure torrent of hot, soapy water from the washing nozzle can be concentrated on the stubborn dishes. The housewife can see what she is doing—a real advantage

Forty pounds pressure behind this dishwasher

This washing nozzle, which attaches to the hot water faucet, furnishes by means of a small thumb lever either soapy or clear water

Specially designed wire baskets hold the dishes firmly in place A splash-guard which pulls up telescope style during washing keeps the splash inside, it is because this splash guard drops down out of the way that this washer goes into a cupboard.

This machine has all the advantages over the old dishpan that a dishwasher is expected to have—it does the job more quickly (5 or 6 minutes), it washes dishes cleaner and in a more sanitary way (by running water), it keeps milady's hands out of dishwater and so does its share toward keeping them soft and white And very important, she can see what she is doing and know the dishes are clean

The Esthonian Cotton-Goods Industry

AS a result of the unsettled conditions in soviet Russia and the consequent loss of the market for the semifinished (unbleached) cloth manufactured there, the Esthonian cotton industry is passing through a crisis which has resulted in the practical closing down of the Kränholm cotton mill at Narva, Esthonia, one of the largest in Europe and the largest in the former Russian Empire, which before the war employed over 10,000 hands and manufactured yearly over 70,000,000 yards of semifinished cotton cloth, which was sent to Russia for bleaching and dyeing and then utilized in that country During the war the importation of raw materials was suspended, and the output of the mill was restricted to the stock on hand. During the German occupation some raw material was obtained, enabling the works to keep going to a limited extent. In 1920 the mill employed about 2000 hands, the output being 7,700,000 to 9,000,000 yards of cotton stuff.

The administration of the mills stated

Making typewriter ribbons out of plain tape

that it was impossible to keep them longer open, as all the capital was tied up in manufactured goods, for which there was no local market and for which they had been unable to find a market abroad. There were in storage in the mills on June 1, 1920, 8,240,259 yards of textiles. From June, 1920, to February, 1921, 6,521,011 yards were manufactured, while during the same period only 26 per cent of the whole production was sold. The Baltic Cotton Mills, Reval, are still working on government orders, but when these are finished the question of closing these mills will also have to be faced. In order to continue manufacturing the mills will have to obtain credits to purchase cotton from the United States, while they continue to hold the manufactured goods until conditions in Russia open up a market for them there or a market elsewhere is found.

A Better Mop Wringer

NO longer is it necessary for a woman to wring the household mop with her hands. This spiral mop wringer is made from one long piece of heavy wire. In use it is placed over a bucket as shown, with one foot of the user on the extension resting on the floor As the mop is pushed down into the spiral-shaped wringer, the user turns the mop slowly to the right. The wires coming in contact with the mop head act as threads and hold the mop securely, wringing all water out, as it is slowly pushed down into the tip of the spiral—By *M M. Hunting*

Getting the mop dry

Our Readers' Point of View

The editors are not responsible for statements made in the correspondence column Anonymous communications cannot be considered, but the names of correspondents will be withheld when so desired

Seaworthy Yachts

To the Editor of the SCIENTIFIC AMERICAN

I have just seen the issue of the SCIENTIFIC AMERICAN in which the "Universal" Yacht Measurement Regulations are commented on I presume, however you are correctly reported as saying that the New York Yacht Club should hesitate to stick to a rule which produced a pair of boats which were afraid to face a summer breeze of more than very moderate weight.

I agree that it was somewhat humiliating to find it injudicious to race on the day referred to; but I can not help pointing out that the remedy does not lie in the one rule or the other The "Universal" rule can not be said to have produced the two boats, because they were unlimited in design and size except in one measurement, namely length on waterline They were only measured for time allowance by the "Universal" rule. To give the rule a proper chance, they ought to have been built to a class under the rule. (Of course, the fact that time allowance was reckoned by measurement under the "Universal" rule could not but have an influence on the designs.) Had all the conditions remained the same, and the time allowance reckoned under the "International" rule, there is little reason to assume that any better sea boats would have been produced.

All I want to say is that I think the desired result could very simply be obtained. The stipulation in the deed of gift that a challenger has to sail across the ocean was made with excellent intention, namely to ensure a seaworthy vessel—*the very thing you are after* Of course we all know how that intention has been frustrated. But by limiting the time taken to sail the course, say to three hours or even less this would ensure the necessary strength in hull, spars, and gear and a more moderate sail spread.

The control of scantlings of the hull without any similar control of spars, sails, and other gear is as if Lloyd's were to class the hull of a steamer without dealing with the machinery

Glasgow Scotland. J R. BARNETT

Industrial and Technical Photography

To the Editor of the SCIENTIFIC AMERICAN

During the last few years photography has more and more developed to be an important factor in industry commerce, and science, and a number of large concerns have established permanent photographic departments of their own as an aid to better efficiency in administration, engineering research buying selling advertising education cooperation and for many special purposes peculiar to the individual needs of the concerns.

All have been striving for the same result—to make photography a help and not merely an added overhead expense As industrial and technical photography not only have come to stay but will get a much larger application in the future than heretofore it would seem wise if all organizations which use photography in one form or another could put their experiences together for the mutual benefit of all.

It is, therefore, the purpose of this letter to ask every one using photography in their plants or organizations, to assist the writer in making a survey of industrial and technical photography by sending him samples of different types of photographs used a short statement of how and why photography is being used as in field, office, plant or research; information as to how far an outside photographer is employed or if the users have photographic departments of their own, together with a history of the development of the same. Methods of mounting, filing and reference are important; also statements of the cost and upkeep of the departments and the value and importance of them

In case one has a photographic department of his own would it be advisable to recruit his help from the photographic profession, or develop some of his men for this work? Should our technical schools develop men as photographical engineers to meet the growing demand for practical industrial photographers?

The writer will compile all this data, and information and together with his experience of eight years in the development of industrial photography make a complete history of the development and uses of the same, to be published in one of our leading technical magazines. The more each one contributes to an article of this kind, the more valuable it becomes.

Would a convention of the users of industrial and technical photography be of any value? If so, would you pledge your presence and support to a convention of this kind, and where would you suggest this to be held?

If enough interest and a large enough attendance for a conference of this kind could be secured, the plan would be to arrange a conference with an exhibition of all forms of technical and industrial photography, and lectures on different photographic subjects in relation to industry, science, research and commerce.

JOHN H. GRAFF,

Industrial Photographer and Photomicroscopist, Brown Company Berlin, N. H.

The Deadly Exhaust in New Dress

To the Editor of the SCIENTIFIC AMERICAN:

The [illegible] of the Department of Health seeks the aid of [illegible] relative to a rather unusual incident [illegible] very near being serious and causing loss of [illegible]

The [illegible] about apparently has been [illegible] line of motor vehicles, and [illegible] serious consequences. The [illegible] New York City is therefore considering [illegible] The following case was reported [illegible] of the 16th Precinct, New [illegible]

W. [illegible] Trenton, N. J was overcome [illegible] motor truck, which [illegible] to New York [illegible] line of [illegible] to the Park [illegible]

An [illegible] investigated the [illegible] and the engine on the forward part of the chassis and the exhaust was immediately in the rear of the flywheel The motor truck body was an open one, carrying a load of boxes covered with a large canvas weather protector The driver and his helper sat on the front seat of the truck and a second helper sat on the rear of the truck to watch while en route, and thus prevent loss of property About halfway down he noticed that he felt sick nauseated, clammy and developed a headache He thought it was incident to indigestion and when nearing the city still continued to feel ill and fainted

The inspector reports that it is his opinion as the truck was speeding along the exhaust gases from the motor entered the vehicle by air suction and the constant inspiration of these poisons gassed the helper in the rear of the truck.

This is the first case of this character reported to the Division of Industrial Hygiene of the New York City Department of Health The investigation is not completed but the danger is so apparent that the matter is called to the attention of the scientific authorities in order that consideration will be given to the proper dispersion of the spent gases as we have observed that a large number of trucks have their muffler very close to the engine in the forward one-third of the chassis whereas other automobiles touring cars and the closed type of automobile sedan and limousine—have the muffler in the rear underneath the body giving the gases an opportunity to escape to the rear of the machine and not be drawn up into the body of the passenger-carrying compartment.

As it is the practice of a large number of merchants to have helpers on the rear of their trucks to aid the drivers in delivering the goods, also to watch the loads while en route we have here a serious menace unless these gases are properly dispersed which can be done by an extension pipe carrying the muffler to the rear of the vehicle instead of discharging the gases as at present in the forward part of the frame

This accident also calls attention to the fact that in physical examinations made of a number of chauffeurs they were found to be suffering generally from chronic carbon monoxide poisoning as expressed by pallor weakness inertia, and a general physical breakdown. The attention of merchants doing large business and operating a number of trucks has been called to this matter with the request that engines on these trucks not be kept running while the rear helpers are unloading also that gases be discharged in such manner as not to enter load if goods are to be shipped any distance so the helper in the rear will not be gassed

It is also feared that probably a number of these helpers are suffering from chronic gas poisoning incident to the practice of improper disposing of these spent gases

Suggestions from yourself and your readers are requested in order to check this menace S DANA HUBBARD M D

Supt Division of Industrial Hygiene

Department of Health New York City

A Question of Inertia

To the Editor of the SCIENTIFIC AMERICAN

Your issue of October 1 1921 contained a paragraph headed Observing the Earth's Movement wherein it was pointed out that this can be noted in a pail of water the liquid turning around in relation to the pail. I tried this experiment, with some misgivings as to the result, and can observe no motion whatever Nor would I expect to, for manifestly when the water had entirely come to rest, a condition admittedly necessary before starting this experiment it will have in reality taken up all of the motion of the pail due to the earth's motion whether of translation or rotation

However I do observe a motion of rotation in a pail of water observed for several hours after filling which was imparted to it *as the water escapes from the spigot in filling*

I cannot but believe that this is the motion Mr Bastin has observed and erroneously ascribed to the rotation of the earth.

Has Mr Bastin who contributes this curiosity or the SCIENTIFIC AMERICAN considered what turmoil would be caused in the oceans were there any tendency for water to refuse to rotate with the earth *with enough force to show in a pail!* Imagine the Indian Ocean or the north Atlantic even trying to rotate clear round in twenty-four hours!

Montchanin Del. E PAUL DU PONT

The Energy of Flies

To the Editor of the SCIENTIFIC AMERICAN

I wonder whether any of your readers can throw any light on the source from where flies get their enormous stores of energy! Here (South England) large numbers of a small dark kind take up their winter quarters under the roof of my house about October Every sunny day they emerge and buzz energetically up and down the sunny side of the walls This they keep up till April or later Thus for six months they have to keep up their vitality expend enormous amounts of energy (for their size) have no visible food of any kind, and in the spring lay their eggs As the sunshine seems indispensable for them to show energy may it not be possible that in some way they have the ability to draw upon the vast stores of power latent in the atom? And what is true of flies seems true also of other insects.

Torrington Devon, England REV CHARLES T PARSONS.

Escalators for Deep Tunnels

To the Editor of the SCIENTIFIC AMERICAN

With reference to your recent editorial on Mr Bolton's idea for low level rapid transit system for New York City your objection to such a system on the ground that the elevating cost would prove very expensive is a valid one if the present method of elevating from the New York subways be used

It occurs to me however that the elevating problem in such a transit system might be decreased considerably by a scheme somewhat similar to that used by the Chicago, Milwaukee & St. Paul Railroad on the mountain divisions in Montana, Idaho and Washington. On this railroad, trains are electrically braked on the down grade with regeneration of current which is turned back into the wires.

My idea is that escalators in place of elevators could be installed to take such a subway system in comparatively small shafts driven on an incline instead of vertically They would be driven electrically automatically and would not require the continuous services of operators as elevators do and they could be so connected electrically so as to regenerate and turn current back into the wires or storage batteries when conditions of heavy down travel prevailed. This current could be used in elevating the same people to the surface at places where the preponderance of travel was upward

I am quite well aware that such a system would involve considerable loss of current in the regeneration system and that the escalators at best use a great deal of current. But I believe that the economy of labor in operating together with such small proportion of current as could be recovered would make escalators considerably cheaper than elevators

LEO G HALL.

Chicago Ill

Sister Ships That Are Not Twins

To the Editor of the SCIENTIFIC AMERICAN

Permit me to congratulate you on your editorial of September 24 1921 Is Airship Travel Profitable?

I wish to call your attention to a minor error which to my mind does not affect the value of the editorial but for the sake of future reference thereto it should be stated that the R34 and R36 are not sister ships in the true sense as the following table compiled from official British sources will show

Ship	R33 R34	R36 R37
Length	639 feet 5 inches	672 feet 2 inches
Diameter	78 feet 9 inches	78 feet 9 inches
Height	91 feet 7 inches	91 feet 7 inches
Volume of capacity	1 955 600 cubic feet	2 101 000 cubic feet
Total lift	59 4 tons	63 8 tons
Weight of hull and fittings	36 1 tons	37.8 tons
Number of engines	5	5
Total horse power	1250	1570
Maximum speed, miles per hour	60	65

The differences in the two classes are very small since the important factor of disposable lift of R36 is less than three tons greater than R34

It is an interesting fact that the Controller of Information of the British Air Ministry issued the following on March 18th 1921 for the information of the press

Since September 1917 many improvements in details of design and construction and economical use of materials have been effected, resulting in the construction of rigid airships in Germany which have practically doubled the lift of L33 or R33 and increased the speed by 20 m p h Thus although R33 was only finished so far back as June 1919 she was at the time of her completion already an obsolete ship and of only about half the performance of the German rigid airships (L 70 class in commission at that date

Since the R33 class is only a little inferior to the R36 class it would be of interest to know what the conclusion would have been if a comparison had been made with the L71 now in the hands of the British Air Ministry which has a disposable lift of almost twenty tons greater than R36 and therefore could accommodate at least double the number of passengers

EDW SCHILDHAUER.

Washington D C

The Flight of Birds

To the Editor of the SCIENTIFIC AMERICAN

At different times I have seen statements attributing various rates of speed to flying birds Especially do I remember an article which gave a maximum speed of 110-130 miles an hour to canvasback and teal ducks otherwise a rate of 170 to 180 feet per second of flight

Having always been a keen autumn hunter of ducks and geese wing shooting exclusively it was necessary to know something of flying speeds and the approximate leads to be given various species in order to avoid a prodigious waste of ammunition I thoroughly investigated this question during the hunting seasons of 1908-9-10 and 1911 on Long Point Bay on the north shore of Lake Erie.

Windy days furnish best Lake Erie shooting The prevailing autumn winds are from northwest and southwest, so that ducks travel usually eastward on such days At point observations were made a narrow tongue of land projects into lake about one mile ending in a rocky reef Passing this flocks usually veered directly northeast to a large inlet and marsh exactly two miles from reef at nearest point by survey Varying inward or outward to direction of wind flocks usually followed an elliptical curve of average length of two and three-fourths miles To cross this space the average time required for teal and bufflehead was three minutes—55 miles per hour Mallard required four minutes in most cases, with an average of 45 miles per hour

The problem at issue was the approximate amount of lead to be allowed a duck at height of 35 yards and 40 yards horizontal distance. Allowing for much variation of ammunition and muzzle pressure it is not safe to estimate speed of shot greater than 900 feet per second or 50 yards for one-quarter second In one-quarter second a mallard will fly 16 feet on average faster ducks 20-25 feet at outset Apart from velocity of the projectile extremely variable as it is there is also wind pressure to measure up along with the moving target Three to four gun lengths is the best lead for mallard; easing in direction wind is blowing

Since ascertaining above facts I have not wasted so much ineffectual ammunition I have tested speed of teal and canvasback and got good results with lead 30 feet at 50 yards. The percentage of hits is about 65 This would disprove any speed of 130 miles per hour Geese fly at varying rates, usually 40 miles per hour in open country If the above facts are of any value to sporting readers they are welcome to them. At least they can easily verify them by actual tests. R. M. J

Saskatchewan.

Recently Patented Inventions

Brief Descriptions of Recently Patented Mechanical and Electrical Devices, Tools, Farm Implements, Etc.

Pertaining to Aeronautics

VARIABLE DIRECTION PROPELLING APPARATUS.—R. S. HEWLIN and M. R. TAYLOR, Norfolk Va. The invention relates to propellers for airships, aeroplanes and the like and particularly to a variable direction propelling apparatus which includes one or more propellers having an axis of rotation which may at will be adjusted to occupy various angles. A purpose of the invention is to provide an apparatus in which the adjusting means is operable independently of the driving means for the propeller so that the propeller can be adjusted to any desired position while it is being rotated.

AEROPLANE.—H J LE PUL, 202 E. 96th St. New York, N Y The object of the invention is to provide an aeroplane arranged to enable the aviator to readily vary the angle of incidence of a wing with a view to insure an easy taking off or landing within a comparatively short space Another object is to permit the operator to vary the angle during flight to compensate for the variation of the load due to the consumption of the fuel thereby being able to maintain a uniform rate of speed.

OIL TANK.—A E. DE SAVE c/o Grand Hotel Mexico City Mexico. This invention has for its object to provide a tank for gasoline which is especially valuable for use on aeroplanes. The tank is constructed with an inner and an outer casing, the latter having an outlet at its bottom connected with a longitudinal tube so that should the tank be penetrated by a bullet the gasolene will be prevented from sparking therefrom by an elastic, absorbent material between the casings and will leak slowly toward the longitudinally extended tube which will serve to discharge it at the rear of the aeroplane

Pertaining to Apparel

ADJUSTABLE HAT LINING OR BANDEAU—M L. VAN HIRLE, 392 5th Ave. New York N Y The object of the invention is to provide an adjustable hat lining or bandeau arranged to permit of securely and quickly adjusting the lining and fastening it in the adjusted position in a hat. Another object is to provide a lining which is simple and durable, adapted to be fastened in a hat without the use of stitches, and to insure the fitting of any style of hat to the wearer's head.

DIAPHRAGM CONFINER — KATHLYN L. BURNS, 74 5th Ave, New York, N Y The invention relates to ladies' wearing apparel and has particular reference to a device for use by corpulent women to confine their busts and so maintain a neat-appearing figure as well as insuring the utmost comfort with respect to their breathing facilities. The device is intended for use beneath the corset, not only acting as a shield, but confining the flesh in a smoother outline than is possible with a garment worn outside the corset.

Electrical Devices

ELECTRIC LANTERN L. A HORNBURG, 1742 So. 27th Street, Omaha, Neb. The invention relates to self-contained electric lanterns particularly suitable for use as railway signal and switch lights. The object is to provide an electric lantern which comprises a metal container adapted to hold a battery two electric incandescent lamps preferably red or white, and a reflector to serve with each light; also switch control and handle The device is durable, reliable and of expensive construction.

DUPLEX LAMP SOCKET—W J KOENIG, deceased; address E. J De Ross, 410 E. 29th St., Brooklyn, N Y Among the objects of the invention are to provide a lamp socket, such as are commonly used in headlights, with a form of resilient contact carrier for cooperating with a lamp base; to provide a simple but highly efficient contact structure and to provide a contact carrier adapted for direct cooperation with a lamp base of either two point or single point contact design.

ELECTRIC FIXTURE.—F L. BUTLER, 740 E. 86th St., Chicago, Ill. This inventor has been granted three patents of a similar nature. The objects are to provide a simple device comprising comparatively few parts, which can be assembled and installed with economy in time and labor Since the insulating member is adapted to receive an ordinary tube formed with a 'running thread" the length of the tube may be varied as required. The device comprises all parts necessary for the effective functioning thereof in ordinary service, and in its assembled condition has the appearance of a more complicated and expensive fixture.

SWITCH —L. S. SUTLIFF, U S. Naval Station, Pearl Harbor Hawaii Among the objects of the invention are to provide a switch for controlling an electric circuit, which may be used as a wall switch a suspended switch, or a straight line switch; to permit the device to be operated by one hand and which will indicate its position without the necessity of employing the characters 'On' and 'Off' to so construct the device that it may be used for the installation of line wires or wires which terminate at the switch.

ELECTRIC FIXTURE.—F L. BUTLER, 740 E. 86th St, Chicago, Ill. The inventor has been granted two patents of a similar nature the object of both being to provide a device having means for guiding the electrical conducting wires from the stem through an opening in the wall of the fixture such means being removable and possessing inherent qualities operating to maintain the same in adjusted position A further object is to provide a device of the type described that can be manufactured cheaply, consists of relatively few parts, and is thoroughly practical commercially

BATTERY CONNECTOR.—W S. DOE, Prospect St., Kent, Ohio. Among the objects of the invention is to provide a battery connector more especially designed for effectively connecting storage batteries in series or multiple when charging the same Another object is to provide a battery connector which is simple and durable, and one which is non-corrosive, acid-proof, not liable to get out of order and capable of being used over and over again

FLASHLIGHT —W S. DOE, Prospect St., Kent, Ohio. The invention has for its particular object to provide a switch arranged to permit the user to conveniently and quickly close or open the same to light or extinguish the lamp. A further object is to provide a switch which is simple and durable in construction and composed of few parts, therefore not easily liable to get out of order

ELECTRIC SWITCH.—W D. THROOP, 190 Laurel Hill Ave, Norwich, Conn The invention relates more particularly to the construction of a pendent switch, an object being to provide such a switch with a longitudinally movable slide member which when operated causes the switch-controlling device to quickly move from one position to another

ELECTRIC CLOTH CUTTER.—F A SCALFARO and J A MCLEOD c/o F Scalfaro, 1419 W Rand St. Chicago, Ill. An object of the invention is to provide a cloth-cutting device comprising a substantially triangular frame having its rearward side formed into a handle and being adapted to be slidably moved on its base, a cutting blade being mounted at the forward end of the device and an electrical mechanism for operating the blade. The device may be guided as desired, since the cloth is under the observation of the operator until engaged by the cutting blade.

Of Interest to Farmers

DISK SHARPENER.—P RINK c/o H D. Paterson Easy Way Mfg Co. Cresco, Iowa. Among the objects of the invention is to provide a device by means of which the disk of an implement, as, for instance a harrow cultivator, or the like may be easily sharpened while in place without the necessity of any motive power other than that provided by the act of drawing the harrow or cultivator ahead with a team or tractor

MIXER.—G W BISHOP JR., 258 Vincent Ave., Lynbrook, N Y The invention has for its object to provide a construction wherein a thorough commingling of fertilizers is secured in a minimum time Another object is to provide a mixer especially adapted for mixing commercial fertilizer wherein a plurality of different forms of stirring blades are used to break up the fertilizer as it is moved. The machine may be moved by power or manually

INCUBATOR.—J KOVAR, address H. Saurl, Taylor, Texas. The invention relates to an automatic heat regulating unit, and more particularly to a device of this nature intended for use with an incubator. By this system the temperature of the incubator or other device with which it is associated will be constantly maintained at a predetermined point. The device is extremely simple, hence economical to manufacture, and is entirely automatic, so that a minimum of attention is required.

BOG CUTTER, GRUBBER AND WEEDER.—C. A. AMBROSE, Carson City, Nevada. The invention is especially designed to cut weeds and water lilies in ditches, such as irrigating ditches, which become clogged up. The device may be adjusted to ditches of different widths and depths and will efficiently cut the growth along the bottom and sides of the ditch. The device may also be employed on level surfaces for cutting weeds or grub. A further object is to provide a device which may be drawn along by draft animals.

Of General Interest

LADDER.—F. M. DE SAUSSURE, c/o Peerless Folding Ladder Co, Greenville, S. C. This invention relates to step-ladders, which may be readily collapsed, and has for its object to provide a ladder in which the side stiles may be folded on each to house the rungs. A further object is to produce such a ladder as will have the prop legs adjustable and readily locked in erected or collapsed condition, and locking means to prevent accidental collapse.

METALLIC PACKING —W L HARRIS, c/o Roberts, 234 E 53d St., New York, N Y The object of the invention is to produce a metal alloy which is comparatively soft, but has certain qualities especially desirable for packing. This packing comprises anti-friction metal alloy in granulated form 82 per cent, anti-friction metal in wool form 6 per cent, asbestos 6 per cent, grease 3 per cent, mica 1 per cent, graphite 1 per cent, and water 1 per cent.

CONTAINER.—J MEARNS, 485 S. 26th St., New York, N. Y This invention relates more particularly to condiment holders, perfume containers and similar small receptacles, an object being to utilize an eggshell, partly filled with plastic material, as the exterior of the container, the eggshell readily lending itself to painting, decorating and ornamentation of various sorts.

COPY HOLDER.—A. N WOODRUFF, 461 Hudson St, New York, N Y It is the primary object of the invention to provide a copy holder in which a line spacing mechanism is moved intermittently from the top to the bottom of the writing bed in such a manner that the line being copied by the operator will at all times be positioned above the line indicator

INSECT PROTECTOR.—L. W STEVENS, Box 332, Everett, Wash. Among the objects of the invention is to prevent insects from gaining access to roosting hens, or crawling up the legs of furniture. The device comprises a cup within which a quantity of oil or the like is adapted to be received so as to completely surround the standard supporting the fowl roost, or the legs of furniture on which it is used.

BAG HOLDER FOR TRUCKS.—E. E. DURKEE, Deer River, Minn An important object of the invention is to provide a bag holder for trucks which will not interfere with the use of the truck and which may be applied to a truck without elaborately altering the construction. A further object is to provide a simple means whereby the bag may be securely held on a hand truck and released when desired.

COLLAR BUTTON.—E. A. KAHL, 190 S. Main St., Wallingford, Conn. The purpose of the invention is to provide a button which will permit of ready application and removal of a collar to and from the shirt without distorting, tearing or in any manner injuring the buttonholes of the collar Furthermore, the invention provides a button and means for preventing the accidental displacement of collar ends having worn or loosely fitting buttonholes.

BOTTLE REFRIGERATOR.—E. J. [illegible], c/o R. W Shaw, Terminal Pharmacy, N.W. Beauregard and St. Joseph Sts., Mobile, Ala. The invention relates to a bottle container and refrigerator adapted for use in stores or homes, to receive bottles containing milk, soft drinks and the like, so that the same will be retained in a cool and sanitary condition in the same refrigerator receiving the foodstuff, whereby both may be kept cool and fresh with the same refrigerating medium with a minimum expenditure of ice.

PANTOGRAPH. — B. C. BENNEVILLE, 530 Ann St., West Hoboken, N. J. Among the objects of the invention is to produce a pantograph which shall be so simple as to be within reach of everybody, and which shall lend itself to any number of uses, such as engraving, drafting and manifold, other uses for the purpose of enlarging or reducing. This form of pantograph is particularly desirable where economy is desired.

HAT CONFORMATOR.—D. FREEDLINE, 1350 Fulton St., Brooklyn, N. Y The general object of this invention is to provide a device of lighter and more simple form than the conformators usually employed. A further object is to provide adjusting means that will readily adapt themselves to the different shapes of heads, at the same time may be locked in adjusted position, against the possibility of changing its form

BELT BUCKLE.—S. ROSENTHAL and S. D. BRIGHTMAN, 1517 47th St., Brooklyn, N. Y An object of the invention is to provide a buckle especially designed for concealing the expanding mechanism of the belt and guarding it from contact with the clothing of the wearer. A further object is to provide a buckle which will be neat and attractive, strong, durable, simple, and practical in construction.

CONDIMENT HOLDER.—D. FREEDLINE, 1350 Fulton St., Brooklyn, N Y. The invention relates more particularly to a dispensing means for salt, an object being to provide a means which operates as an effective closure for the condiment holder when the latter is in its normal position, and which operates to effectually discharge a quantity of the condiment when the holder is inverted and shaken.

MANHOLE COVER.—J H. THOMSEN, 2614 W First St., Davenport, Iowa. The object is to provide a cover plate having inner and outer spaced annular ribs formed on the side, spaced pairs of radial arms extending through and turned into said ribs, the inner ribs being provided with openings slidably receiving the inner portions of the pairs of arms, pairs of latch bars carried by the outer end of the pairs of arms, and coiled springs confined between the arms for separating and urging the latch bars outwardly

HOLDER AND TIE.—A H EVA, 206 Cumberland Rd., San Antonio, Texas. The object of the invention is to provide a holder for engagement by the laces of shoes, leggings, corsets and the like, wherein a simple, inexpensive attachment is provided, which may be easily connected with the shoe, and in which the end of the lace may be engaged in such manner that it cannot become accidentally displaced

SWAB.—W F LEECH, 941 Glengyle Place, Chicago, Ill. More particularly the invention relates to a device for use in connection with iodin or any other liquid, or semi-fluid. An object is to provide a swab which will be entirely sanitary, which will permit the removal of the cotton after application. A further object is to provide means for holding absorbent cotton on the end of the swab which preferably forms a portion of a bottle stopper which operates as a handle.

SPRAYER.—J. T. FLUHER, North End Station, Detroit, Mich. The invention relates to an apparatus for spraying lawns, gardens, or the like. The device more particularly relates to a sprayer employing laterally extending spraying arms mounted to revolve about a vertical axis. The general object is to provide a sprayer with a view to effect a proper distribution of the spray in the gradually increasing zones covered by the sprayer arms and their appurtenances.

WALL BRACKET.—R. F. [illegible], 20 Webster St., Middleboro, Mass. Among the objects of the invention is to provide a hanger for hot water bottles and the like, having means whereby the flexible body of the bottle may be suspended in such manner that it will not [illegible]. A further object is to provide a hanger having a [illegible] hook provided at one end with an [illegible] hole and at the other end with a bill adapted to engage [illegible] hot water bottle.

HORSE COLLAR.—S. C. Winslow, Ore, N. D. The purpose of this invention is to provide a horse collar constructed in the main of coiled contractile springs so associated with each other as to provide a collar of durable and efficient construction, and having the required flexibility to render it self-conforming with respect to the horse's neck.

PROTECTOR FOR DESKS.—E. H. Masters, 86 Glendale Road, Webster Groves, Mo. The invention has for its object to provide a rubber protector to prevent marring and splintering of desk edges and the desk chair when they are struck together, the protectors being arranged at such point on the desk edges that they will be engaged by the chair, to prevent injury to either the desk or the chair.

MOUSE TRAP.—N H. Ashcraft and W. A. Baldwin, 418 Sixth Ave., Dawson, Ga. This invention has for its object to provide a trap in the form of a sleeve which may be connected with an ordinary fruit jar at one end, and wherein the sleeve has mechanism in connection therewith for permitting the free entrance of a mouse or rat to the jar, but for preventing the escape of the mouse or rat from the jar

HAND NUTCRACKER.—H. C. Atwood, Box 868, Ardmore, Okla. This invention has reference to a simple nutcracker adapted primarily to be operated by hand. An object is to provide means whereby pressure can be easily applied with sufficient power to crack various kinds of small nuts quickly and without breaking the same into small parts. The device is provided with means whereby it may be detachably mounted on the edge of a table or the like.

PHONOGRAPHIC NEEDLE.—T Fletcher, 125 No. Flores St., San Antonio, Texas. An important object is to provide a needle which by being turned upon its longitudinal axis will function as a soft, medium or loud needle. A further object is that by making the shank of the needle more flexible in one position than it is in another it is capable of absorbing most of the strong vibrations communicated to it, and by so doing cut them out from reaching diaphragm, at the same time preserving the overtones which are often lost in reproduction.

LIFEBOAT OR RAFT.—W. Stewart, 18 Taylor St., Newark, N J One of the principal objects of the invention is to provide a lifeboat or raft of identical construction on its upper or lower sides whereby the same will properly function irrespective of its launching, thereby eliminating the necessity of expensive tackle for lowering the same into the water A further object is to include a plurality of water-tight compartments, rendering the same non-sinkable and providing storage room for provisions and water

UMBRELLA HOLDER.—C. A Cooper, c/o Mrs. R. Dynes, 676 Riverside Drive, New York, N Y Among the objects of the invention is to provide an umbrella holder designed to hold individual umbrellas in erect position and in such manner that any drip water from the umbrella will be conveyed along the tip into the interior of the holder, so that the water will not reach the floor, and yet come as little as possible into deteriorating contact with the crown of the umbrella.

SANITARY FLYTRAP.—A. B. Heller, Hamburg, Pa. The general object of the invention is to provide a structure provided with locking means and adapted to be set up from a flat form to present a bottom and sides, together with means to retain flypaper supported on the bottom of the structure. The trap is so constructed that the flypaper can not possibly contact with surrounding objects, and the trap may be burned, making it thoroughly sanitary

FLUE CLEANER.—W Meckville, R.R. No. 4, Cedar Rapids, Iowa. This invention aims to provide a simple and efficient flue cleaner which shall operate in such a manner as to automatically conform to varying widths of flues, so that upon being moved through the flue the latter will be efficiently cleaned. A further object is to provide a device in which those portions subject to wear may readily be renewed.

WINDOW.—L. Lanz, P O. Box 1666, Habana, Cuba. More particularly the invention relates to windows in which the sliding sashes have line contact with the guide members engaged thereby on the window frame. The object is to provide a construction and arrangement of the jamb members of the frame and the sash members to insure the line contact and be capable of embodiment generally in windows having sliding sashes.

BAG SUPPORT.—Mary C. Spraguins, 1924 Boulevard, Jersey City N J An object of the invention is to provide a bracket or clamping device which may be readily mounted on the table or other support so that the bag will be held in open position for receiving any desired article. Another object is to provide a support for a scrap bag in a sewing-room, general utility bag or a trash bag, arranged to be supported with its mouth open when in use, and the mouth section folded when not in use (See Fig 1)

ANIMAL TRAP.—A F Renken, Crete, Neb. This invention relates particularly to a trap which is primarily designed to catch pocket gophers. An object is to provide means for maintaining the trap at various positions of adjustment when the trap is in set position so that it may be suited for use in holes of different sizes. A further object is to provide a metal trap which is simple, strong and practical in use.

FASTENER FOR HANDBAG.—M Sloane, 228 Roebling St. Brooklyn N Y The general object of the invention is to provide a fastening upon which reliance may be placed to hold the bag in closed position, and make the surreptitious opening of the bag attended with greater difficulties than when reliance is placed solely upon the clasps or the catch usually provided on bags at the top

ARTIFICIAL BAIT.—J Frame, c/o Penobscot Coal Co., Searsport, Maine. The general object of the invention is to provide an artificial bait with means for giving motions more or less in simulation of the natural motions of a minnow by flexing the articulated tail portion, and by novel fins to cause the bait to turn to one side and rise toward the surface, and to the opposite side and produce a diving action. The hooks have flexible guards concealing them, but yielding to the attack of a fish. Fish oil may be caused to exude from the bait through its tail and sides as a lure. (See Fig. 2.)

ALLOY.—F Milliken 18th floor, 110 William St., New York, N. Y The object of the invention is to provide an acid-resisting alloy capable of being rolled, drawn forged, or worked in other ways while being cold, to form rods, plates, sheets, wires, tubing and the like. The alloy consists of the following ingredients: Copper 60-70 per cent, zinc 19-24 per cent, nickel 9-12 per cent, iron 1-3½ per cent, and manganese copper 1 per cent.

MATTRESS.—P Gardner, 240 53rd St. Brooklyn, N Y Among the objects of the invention is to provide a mattress made up of a plurality of sections which are in a very simple and effective manner completely interchangeable, whereby the supporting surface of the mattress may be very readily changed so that the entire surface of the mattress is uniformly worn out and thus the life of the mattress is greatly lengthened.

CURTAIN SUPPORT.—H H Dierks 858 95th St., Woodhaven, L. I., N Y The invention relates to means for supporting a panel curtain on a door or window The general object is to provide a device in the nature of a continuous twisted wire adapted to be applied to a window or door frame or separate frame, and having hooks for engaging the curtain at intervals on all four sides so as to give an even support, and loops to receive nails to fasten the wire to the door or window.

CHRISTMAS TREE STAND.—E. A. Wilkes, 8448 Greenwich Ave., Chicago, Ill. Among the objects of the invention is to provide a stand which will serve to rigidly support a tree in upright position and to provide illuminating means associated with the stand for throwing light upwardly on the tree. A further object is to provide a varicolored translucent revolving element which will serve to give a constantly changing illumination to the tree. (See Fig 3)

REEL.—R. Cassidy, 12 W 1st St., Mansfield Ohio. This invention relates more particularly to reels designed for use in connection with clotheslines. An object is to provide a device which will permit the clothesline to be reeled or unreeled without any portion coming in contact with the ground to soil the line A further object is to provide a reel which is portable and can be conveniently supported in one hand and manipulated by the other

LETTER SHEET.—D D Schulman deceased, address Florence R Schulman 416 W 83rd St., New York, N Y The objects of the invention are to provide a commercial letter sheet adapted to carry a display advertisement of goods, such display being of pictorial character and of fixed form, such as that standardized by the manufacturer in obtaining publicity but which picture shall not trespass upon the sheet reserved for written communications.

ADJUSTABLE JAR COVER OPENER.—J A McLeod and Ella A Dauton 744 S Campbell Ave Chicago Ill. Among the objects of the invention is to provide a jar cover opener that can be readily and quickly adjusted to positively grip the top of any bottle, jar or the like, to remove the same. A further object is to provide a device which is simple in construction and operation, and which is not likely to easily get out of order

SHEET METAL BACKING FRAME.—J Mandel, 1808 1st Ave. New York, N Y The invention relates to backing frames for advertising cards, and has for an object to provide a construction in which a plurality of sheet metal members are telescopically arranged for receiving a single card or a plurality of small cards without changing the general appearance of the device, and giving a uniform edge so as to have the appearance of a complete frame for each card.

FLASHING.—O. Boll, 418 Stevens St, West Hoboken N J This inventor has been granted two patents of a similar nature They relate to flashings such as are employed on a building at the siding on a roof at a window or door frame, or in connection with a chimney The general object of the invention is to promote facility in the proper installation of a flashing and the securing of the same in position and provide for ventilating the space beneath the flashing owing to the sweating of flashings at the interior and to provide a flashing that may be wholly or partially removable in making repairs.

FILM WINDING MEANS FOR CAMERAS.—H H Berry 2735 Webster Ave Bronx, N Y Among the objects of the invention are to provide means for causing the turning of the winding spool by a slidable actuating device accessible *from the exterior as well as means to vary the* winding action to accord with the increasing diameter of the spool as the film is wound thereon.

FRUIT PICKER'S BAG.—W F Keeline, deceased Mrs. W F Keeline, 445 Main St. El Centro, Calif The object of the invention is to provide a bag whose upper portion is held open at all times adjacent to its receiving mouth and has at the same time a flexible portion adjacent to the user's body to avoid the discomfort of rigid, unyielding or stiff bag mouth supports as commonly used at the present time The invention is particularly intended to provide comfort for the user (See Fig 4)

COFFEE CAN AND ATTACHMENT W S. Miller, 1185 4th St. San Diego, Calif. The invention has for its object to provide means for delivering a predetermined quantity of the contents of a can without opening the can and thus preserving the aroma of the coffee or other contents. Another object is to provide an airtight removable cover for the receptacle, a raised horizontal bottom in which is placed a measuring device in the form of a rotatable cylinder with openings for filling the cylinder from the contents of the can and closing the same that the contents of the cylinder may be emptied.

TRAP NEST.—J F Cook 846 Brunswick St. San Francisco, Calif An object of the invention is to provide a poultry nest which can be so arranged as to train a hen to use a certain nest which will facilitate the keeping of records. Another object is to provide a nest which is capable of use as a trap of such character that when the hen enters the nest egress will be prevented or it may be arranged to permit perfect freedom of ingress and egress.

ROLLING CRUTCH.—M D. Scott, 214 No. Tremont St. Kewanee Ill. The invention relates to what is known as walking chairs, having in connection therewith a seat whereby the user may propel himself along and readily and easily rest between walking periods. The primary object is to provide an arrangement by which the seat is readily shiftable and horizontally adjusted and in which the arm rests may be conveniently adjusted to the body of the user

REMINDER.—W H Collins, 200 Boulevard, Summit, N J The invention has for its object to provide a construction which will be applicable as a kitchen reminder or as a reminder in any other place, and to provide means for presenting to view in a classified manner a large number of articles needful in a house or other place the indicating members being slidingly mounted in slots formed with a series of depressions for holding the members at any desired point.

HOLLOW TILE.—J V Close, 74 Franklin Ave. Norwalk, Conn. Among the objects of the invention is to provide a hollow block or tile construction which will make it impossible for moisture to pass through the wall, following the courses of the mortar Another object is to provide what may be termed a combination hollow tile having peculiar facilities for adapting it for the formation of special structures, such as corners, turns or walls of irregular length.

TABLE.—G E Tomlinson, Winchester Ky An object of this invention is to provide a sectional or collapsible table composed of a minimum number of parts, which can be quickly and readily put together to form a strong compact table. The table comprises a top which may be in one piece or may be composed of pieces, and the device is fastened with resilient locking means, the entire structure being collapsible and composed of parts which can be quickly dismantled and stored in the smallest possible space

Hardware and Tools

WRENCH.—A. W Minney, 221 E. Fremont St. Stockton Calif The object of this invention is to provide a wrench which is simple and durable in construction reliable in operation readily adjustable, and which is adapted to powerfully grip the object or work and to apply a powerful torque thereto without distorting or breaking the elements of the wrench

Fig. 1.—This bag support is the invention of Mary C. Spraguins, of Jersey City, N. J.

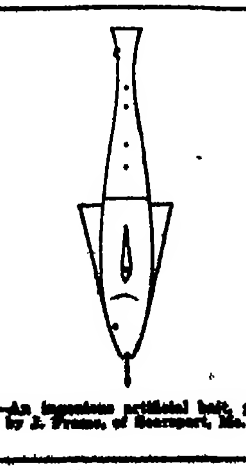


Fig. 2.—An ingenious artificial bait, patented by J. Frame, of Searsport, Me.

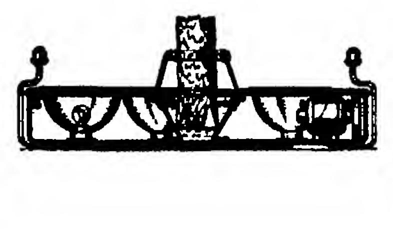


Fig. 3.—This elaborate Christmas tree stand with flood lights and motor-driven color-wheel for providing varicolored lights, is the invention of E. A. Wilkes, Chicago, Ill.

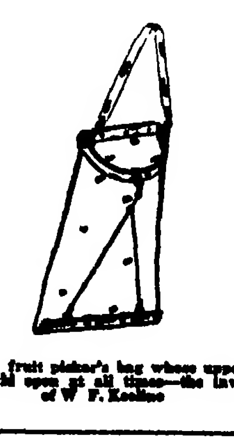


Fig. 4.—A fruit picker's bag whose upper portion is held open at all times—the invention of W F. Keeline

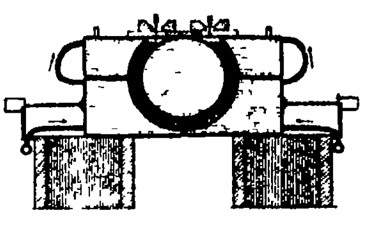


Fig. 5.—This ingenious scheme for heating water and generating steam as by products of a slag furnace, is the invention of E. E. James of San Francisco, Calif

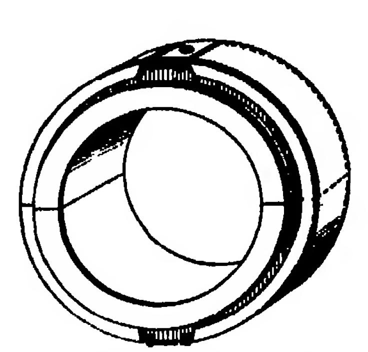


Fig. 6.—A safety split set collar which protects persons working around machinery—the invention of J. C. Field, of Letcher, La.

Fig. 7.—This simple tool serves to engage the valve tappet so as to impart a grinding movement. Invention of H. C. Brown, Philadelphia, Pa.

Fig. 8.—New method of making piston rings, invented by H. Stevens, of Newark, N. J., which causes the density of the grain to take an angular course.

SAW FITTING TOOL.—G ANDERSON 222 Minor Ave., North, Seattle Wash Among the objects of the invention is to provide a device including a vertically adjustable swage gage member provided with a plurality of laterally projecting gage points, so located that when gaging the length of a raker tooth of a saw they will be out of registry with the two points of the raker tooth, whereby the unused gage point will not interfere in the operation by coming in contact with the opposite tooth point.

BOILER TUBE BRUSH.—J BERGESEN, Sr., 361 E. 81st St., Brooklyn, N Y This invention has particular reference to a type of brush which is adapted to be forced, in a well-known manner, by means of any suitable fluid pressure through the tubes of a boiler to clean the same. An object is to provide means whereby the brush will not cant or jam in the tubes, and to provide means for clamping the bristles on the brush in such way that they can be very easily removed.

TOOL HOLDER.—R. T CARSON, Kinderhook Knitting Co. Kinderhook, N Y The invention relates to lathe tools. The device consists of an attachment in the nature of a locking or retaining device which seeks for its object to provide a positive means for clamping the yoke in its adjusted position and locking the tool against relative movement with respect to the holder The attachment is simple and inexpensive.

SAW SET.—J W INGLETON, Box 962, Astoria, Ore. The invention relates more particularly to a readily adjustable device of this nature which is of simple construction, may be conveniently utilized and will be durable and effective. The device is adaptable by virtue of its adjustments to both cross-cut and hand saws, and may be utilized with but slight change for saws of various types.

PACKING TOOL.—K REBOSKAUG, 309 Warren St., Brooklyn, N Y The invention relates to a packing tool particularly adapted for use in connection with the packing of tubes. One of the principal objects is to provide a device which shall be simple in construction and may be operated by relatively unskilled labor in the application of packing material to the ends of tubes and heads applied thereto, by means of which the tube will be evenly and correctly packed.

WINDOW OR KEY LOCK.—B. LICHTMAN, c/o Davis, 52 Smith St. Brooklyn, N Y The invention relates to builders' hardware. Among the objects is to provide a safety device for cooperating with a locking member or catch which, when in adjusted position, will serve to prevent or materially reduce the likelihood of the catch or lock being moved or released to permit the opening of the window or door by any unauthorized person.

WRENCH.—A. W MINNEY, Stockton, Calif The object of the invention is to provide a tool which is especially adapted for use as a wrench and adapted, when so used, to powerfully grip either round or polygonal objects irrespective of the position of the wrench with respect to such objects, and which is of simple and durable construction, reliable and easy to operate.

HUB FOR GEARS, PULLEYS AND TOOLS.—J L. GLENDENON R. No. 1 Box 75, Bexley, Ala The invention relates to gears, pulleys and the like, or tools, and more particularly to a hub construction therefor by which the body or rim of the gear, pulley or tool is detachably fixed to the hub, so that the part subject to wear and tear may be removed for repair in case of breakage, or for changing speeds where the same hub may be used for different sizes of gears or the like.

MICROMETER CALIPER.—G. COUGHES, 173 W 1st St., Oswego, N Y An object of the invention is to provide a readily adjustable, easy reading arrangement which will obviate the necessity for a vernier and will permit of easy interchange of spindles for different classes of work. A further object is to provide an apparatus in which the various portions are detachably connected so as to facilitate their removal for purposes of substitution and repair

NIPPLE GRIP.—W P STRICKLAND 4532 Cottage Grove Ave., Chicago, Ill. This invention has for its object to provide a device for engaging a spoke of a bicycle or the like and the spoke nut thereon to permit operation of the latter without subjecting the device to a lateral stress. A further object is to provide a device that can be quickly adjusted and easily engaged with work of various sizes, which contains comparatively few parts, and is therefore durable and inexpensive to manufacture.

DOOR OPENING AND CLOSING DEVICE.—G C. CIRAC, c/o R. A. Cahalan, Evans and Railroad Ave., San Francisco, Calif The invention has reference more particularly to a manually operated device which is adapted to be mounted in association with a door for opening and closing the same, and further is a convenient means for locking the door closed when occasion arises. The invention is especially adaptable to the doors of ice boxes and like compartments.

TRAPPER'S TOOL.—W R. LASHNEY, Box 451, Hardin, Mont. Among the objects of this invention is the provision of a combination tool which will greatly facilitate the setting and removal of a trap, and which will afford convenient means for preparing the ground to permit of the positioning of the trap and trap anchor Another object is to provide a tool which may be folded to occupy a minimum amount of space when not in use, whereby the same may be carried easily as a part of the trapper's outfit.

TWISTING TOOL.—J SCHNEIDER, 412 Walnut St., Roselle Park, N J The invention relates to twisting tools generally used for splicing wires or strands. An object is to produce a tool having special facilities for rendering it capable of use on splicing work where various sized splicing sleeves and strands are necessarily employed. It is also an object to produce a tool having convenient clamping means for mounting the device on parts to be twisted.

Heating and Lighting

FISH COOKER.—A S. DAVIES, 44 Garfield St., Santa Cruz, Calif An object of the invention is to provide a cooking apparatus to be used in connection with fish canneries, an endless belt traveling through a cooking chamber being employed to convey and continuously cook the fish. Another object is to provide a screen of porous material between the fire chamber and cooking chamber to hold down the flames and absorb the oil dripping from the fish as it cooks.

SLAG FURNACE.—E. E. JAMES, 221 Mason St., San Francisco, Calif The invention refers particularly to an apparatus for heating water and generating steam by means of utilizing the existing heat in the slag of blast furnaces. An object is to produce an apparatus which will be capable of utilizing large quantities of slag. The apparatus comprises a steam boiler and means for confining a quantity of hot slag around the same, the lower portion of said means being capable of removal from the bottom of the boiler to release the exhausted slag (See Fig. 5.)

ARCH FOR FIREBOXES.—F J SPILLANE, address Mack Engineering & Supply Co., 120 Liberty St., New York, N Y The invention relates to oil-burning steam boilers. Its object is to provide an arch arranged to permit of readily assembling the sections at the ends of the fireboxes and to allow of readily removing or replacing a burned-out section. Another object is to provide a protecting means for the joint formed by the firebox with the back [illegible] with a view to preventing flames reaching the joint and to prevent a too rapid cooling of the joint after the flame is extinguished.

REGULATOR.—L J FOLTZ, 508 1st Ave. So., Seattle, Wash. An object of the invention is the construction of a regulator for use in connection with a gas burner by means of which the burner may be caused to produce a "pilot" size flame or one in which the entire battery of burners may exert their maximum output, the gas being thrown straight into the mixing tube of the burner to produce an ideal mixture and a good flame.

HYDROCARBON BURNER.—A. KAUFMAN, 2269 E. 79th St., Cleveland, Ohio. Among the objects of the invention is to provide a burner possessing efficiency with respect to the amount of fuel consumed and the degree of heat that it is capable of delivering, to provide a burner that is clean, sanitary, and inoffensive, and one which has satisfactory, lasting qualities. A further object is to simplify and improve the construction of the gas generator with respect to durability

THERMOSTATIC TRAP.—R. N TRANE, c/o The Trane Co., La Crosse, Wis. The invention relates to thermostatic valves or traps for radiators or other steam appliances, and has for its object to provide a construction which will be both sensitive and powerful. A further object is to provide a trap with a thermostatic member for opening and closing the valve, and a double valve structure to take care of high pressures, and a small valve forming part of the head of the valve, sensitive to small changes in temperature as well as acting in connection with high pressure.

Machines and Mechanical Devices

TEST INDICATOR.—G. J GENUNG, 904 19th Ave., Beaver Falls, Pa. The invention has for its object to provide a device of the character specified, for permitting the accuracy of surfaces to be determined, wherein small openings of considerable depth may be measured. This device permits the operator to test or gage the entire surface of a long hole of relatively small diameter or to reach into a small aperture of a jig or any other piece of machinery to be tested.

SAFETY SPLIT SET COLLAR.—J C. FIELD, Letcher, La. The invention more particularly relates to a split set collar designed to afford safety to persons working about machinery, so as to prevent catching one's clothes thereon and obviating the danger of wrapping or winding clothing thereon, due to the fact that the device has no open spaces on its face or protruding screws or bolts as in the ordinary set collar. The collar may be quickly installed without removal of the shaft, and affords an absolutely smooth exposed surface. (See Fig. 6.)

PUMP.—J A. WHEELING, Box 186, Houlston, Okla. The object of the invention is to provide a pump especially adapted for use in deep wells, wherein means is provided in connection with the pump for settling the sand before it comes into contact with the valves and piston, and wherein other means is provided with the piston for preventing the entrance of sand to the plunger or piston and between the packing thereof and the barrel.

VALVE AND GRINDING MECHANISM THEREFOR.—H. C. BROWN, 43 E. Logan St., Germantown, Philadelphia, Pa. Among the objects of the invention is to provide a valve and a grinding mechanism therefor which may be moved into locked engagement with the valve to impart a simultaneous rotary and longitudinal movement in both directions during the grinding operation, for which purpose the inventor provides a special tool comprising a shank and field [illegible] (See Fig. 7)

THREAD CUTTING AND TAPPING MACHINE.—M. [illegible] [illegible] An object of this invention is to provide means for supporting and mounting a longitudinally movable chuck and provide means for turning the chuck in either direction. A further object is to provide means for clamping the work either in a horizontal or vertical position, and to produce a machine which will be simple, strong and durable in use.

SEWING MACHINE ATTACHMENT.—D. KWON, c/o Bailey Furniture Co., Honolulu, Territory of Hawaii. More particularly the invention relates to an attachment adapted to be connected to the head of the sewing machine and support the extension board when the latter is folded, and when the machine is to be dropped preventing injury to the board and to the machine. The attachment will not interfere in any way with the operation of the machine.

PROTECTING OBJECTS FROM WAVE ACTION.—P. BRASHER, 11 Broadway, New York, N Y The invention relates to means for protecting objects from wave action, and more particularly to a means of discharging air upwardly from perforated pipes through the water for breaking up the waves, a further object being to provide means for discharging from the apparatus sand or foreign matter accumulating therein.

METHOD OF MAKING PISTON RINGS.—H. STEVENS, 671 So. 14 St., Newark, N. J The invention particularly relates to hammered piston rings. By the usual method the impact of the blows are liable to cause slightly raised and hardened spots on the outer peripheral face. By this invention an angular groove is provided having angular walls against which the force of the hammer blows are received. By this arrangement the density of the grain formed is forced to take an angular course, thus producing the hardened spots on the upper or lower edges of the ring. (See Fig. 8.)

SILK THROWING MACHINE.—F. H. [illegible], 104 E. 28th St., New York, N. Y. The object of the invention is to provide a machine arranged to form from two or more raw silk ends a crape or high twist thread in one continuous operation on a single machine. Another object is to produce a large amount of crape thread in a comparatively short time, and one having a uniform twist throughout its length.

JACQUARD DRUM.—G. G. L. [illegible], 484 Spring St., Elizabeth, N. J. The object of this invention is to provide a construction wherein a drum or wheel structure is used for holding the pins instead of an ordinary link structure. A further object is to provide knitting machines with means for carrying a series of pins capable of acting on the needle bars correctly, and preventing any appreciable tilting or loose side motion of the pins.

COLLAPSIBLE CORE.—P. DE MARIA, Clifton, N. J. This inventor has been granted three patents of a similar nature, the objects being to produce a collapsible core comprising a plurality of articulated sections so constructed and connected together as to afford a [illegible] of movement to the pivoted parts and thus greatly facilitate the removal of the built-up plate or casing without subjecting the metal to distorting strain or pressure. A further object is to provide a key [illegible] means to move the [illegible] and in an oblique direction, and to provide means whereby the key [illegible] may be [illegible] and supported within [illegible] of the [illegible].

APPARATUS FOR AND PROCESS OF MAKING PNEUMATIC [illegible] [illegible]

[illegible] and a [illegible] if desired a [illegible] may be applied during the [illegible].

VALVE CONTROL FLOAT.—C [illegible], [illegible] Avenue, Brooklyn, N Y This invention relates particularly to a float construction especially designed for use in combination with the supply valves for ink reservoir tanks of large printing presses. One of the principal objects is to provide a float construction of extremely buoyant material, and to provide means to prevent the sticking or adherence of the same to the sediment on the top and bottom of the tank. Another object is to provide a float so shaped as to induce its lifting power under all conditions.

GUARD FOR PUNCHING MACHINE.—S B WOODWARD, 212 Rosemount Ave Trenton N J An important object of this invention is to provide for punching machines which may be attached to either side and which will effectively prevent the operator from being injured when the movable die member carried by the ram descends. A further object is to provide a guard having means whereby the zone of action of the same may be adjusted

FRUIT SIZING MACHINE.—A H McINTYRE, Dunedin, Fla. This invention has for its object to provide a machine particularly adapted for sizing peaches and similar fragile fruits in which a relatively slow operating machine shall have a relatively large capacity and in which the fruit shall be gently supported, transported and separated into lots of substantially uniform size, without the liability of bruising and injuring the fruit.

AUTOMATIC TRIP MOTION —M BERNAUDIN, c/o De Van Schuck, 472 West End Ave New York N Y The invention relates particularly to a trip motion applicable to use with printing press. An object is to provide a simple compact and readily attachable means for any ordinary printing press whereby the paper-feed roll may be moved to a non-printing position whenever the paper is not gripped and moved to the printing position

MACHINE FOR MAKING HAT LINING TIPS.—E BELL, 27 Bond St. New York, N Y An object of the invention is to provide a machine which will automatically moisten part of the hat lining immediately before the tip is manually pressed A further object is to provide a machine formed with moistening and pressing means acting in certain relation to each other for causing the adhesive to flow into the body or covering of a lining tip and thereby dispense with the use of stitching for holding the parts together

PUMPING MECHANISM —E S LIDSTONE Box 208 Gatun Canal Zone Among the objects of the invention is to provide a pumping mechanism capable of being quickly assembled and disassembled and packed in a small space when disassembled which is particularly advantageous when the pump is to be used in connection with automobiles. Another object is the provision of a plurality of cylinders so that the pumping action may be rapid

BOX FINISHING MACHINE.—A BELL, 219 Teaneck Road Ridgefield Park, N J Among the objects of the invention is to provide a finishing machine for paper boxes which will function to obtain a more perfect finish to the box than is possible by hand labor in which means is provided to compensate for the great variance in the size of the boxes and lids, and in which means of adjustment can be obtained whereby the same will properly handle boxes and lids made from material of different thicknesses.

BORING MACHINE.—W F McCARTY c/o Defiance Machine Works, Defiance, Ohio. Among the objects of the invention is to provide a machine designed to quickly and accurately rough bore and ream or finish single units or a plurality of units cast en bloc Another object is to carry out several boring operations simultaneously on a corresponding number of castings while the attendant of the machine removes the finished product and replaces it by another casting to be bored.

UNIFORM MOTION UNIVERSAL JOINT.—W J. FRANCKE, Highland Park, N J An object is to provide a uniform motion universal joint arranged to insure a uniform transmission of power from the driving shaft to the driven shaft irrespective of the angular position of the shaft. Another object is to positively drive one shaft from the other with the angular advance of the [illegible].

[illegible]

GRAIN DRIER.—W PUTNAM and S. D LONGMAN c/o Longman Bros Thornwell, La The invention relates to an arrangement of racks consisting each of a series of revolving screens or cylinders which serve to propel the grain through the drier and allow a free circulation of air to thoroughly dry the grain the air being heated at one point in the circuit and after passing through the drier returns to such heating point so that the same air can be utilized in a continuous circulation

FLEXIBLE COUPLING —W J FRANCKE Highland Park N J Among the objects of this invention is to provide a flexible coupling arranged to readily compensate for angular or parallel misalignment of a driving shaft and a driven shaft A further object is to reduce the error of transmission to within the limit of the thickness of the lubricating film between the working parts

COLLAPSIBLE SHAFT H T RICE I R 875 Norfolk N Y An object of the invention is to provide a shaft which is capable of expansion and contraction and the means employed for adjusting the diameter is positive in its action A further object is to provide an expansion shaft which dispenses with the necessity of springs and like devices and which is of extremely simple construction strong and durable in use

APPARATUS FOR MAKING ORNAMENTAL ROPE —C. A REED Williamsport Pa. The invention relates to an attachment for sewing machines The purpose is to provide an apparatus which simultaneously stitches and cuts strips of paper comprised in the ornamental rope so that when the strips are subjected to twisting operation by a device separate and independent from the present invention the ornamental rope is produced

WHEEL AND SHAFT —J C HUDSON Box 486 German, Texas An object of the invention is to provide a wheel and shaft of the character known as bull and calf wheels used in drilling oil and gas wells wherein the shaft is provided near each end with a hub or polygonal cross section and the wheel body consisting of a hub portion a rim and connecting spokes, has the hub portion shaped to fit upon the polygonal hub of the shaft, the parts being secured together to provide a rigid structure

DYNAMIC SYSTEM ADAPTED TO IMPART TO A MECHANICAL SYSTEM A RAPID MOVEMENT OF OSCILLATION —L L B DENIS 116 Boulevard de Manilmontant Paris France This invention relates to a dynamic system permitting to impart to a non rigid mechanical system a rigid movement of oscillation with the minimum of loss work by effects of inertia and by avoiding the prejudicious effects of resonance The system is characterized by the combination of an elastic system through the medium of which the system to be actuated is connected to a fixed point.

CHECKING MACHINE.—F R WAINWRIGHT 322 7th St Jersey City N J An object of this invention is to provide a checking machine which will permit of the making of a permanent record so that slips may be tallied with this record as well as with the cash on hand. The machine includes a plurality of projectable type-carrying members, movable inking strips adapted to normally bear against the type to permit the same to render an imprint, the type carried by the members moving the strips out of their path of travel upon being projected

I-BEAM TROLLEY —W S HALSEY care of Dover Hotel Dover N J The invention relates to overhead trolleys Its object is to provide an I-beam trolley having means partly disposed between the web of the I beam and the adjacent end of a truck wheel for supporting the latter for rolling contact with the lower flange of the I beam A further object is to provide a device so constructed that the journal pin for supporting the wheel can be reduced to a minimum and the friction reduced without the necessity of providing anti-friction bearings.

PRINTER'S CHASE.—E. JACKSON c/o C. J O'Brien 21 N William St. New York N Y The object of the invention is to provide a printer's chase arranged to hold securely the type suspended without danger of dropping out in handling the chase. Another object is to permit of filling the chase completely with type and without requiring the use of quoins and other filling and locking furniture.

LABEL FEED DEVICE.—J G. LEAVITT address H. L. Harrington Utah Canning Co., 29th St. and Pacific Ave., Ogden Utah The invention relates more particularly to devices for feeding labels to be fixed to the ends of cans on which a daub of paste or adhesive has been previously located so that the contact of this adhesive on the can with the label will remove a single label from the feed device.

WAX MELTING MACHINE AND SEAL MAKER.—J A. [illegible] Nos. 9-11 [illegible] Bldg. [illegible], S. C. The object of the invention is to provide a container for holding a quantity of wax and having means for heating the wax to melt the same and for delivering small quantities when desired on to the object to be sealed, as for instance a document or package and having means operable at will for making an impress on the wax delivered on to the object to be sealed.

STAYBOLT CHUCK —G COUSINS 173 W 1st St Oswego, N Y The invention relates generally to the manipulation of staybolts in screwing and removing the same from operative position wherever used The object is to provide an effective, strong and durable implement by which to engage and rotate a staybolt in either direction and a still further object is the provision of an implement in which the jaws may be readily adjusted and actually forced into operative connection with the projecting portion of a staybolt.

BLOCK MOLDING MACHINE.—J S DEWNAR c/o The Continental Asphalt & Petroleum Co 1615 American Exchange Bank Bldg Dallas Texas The invention particularly relates to a machine for molding blocks or bricks from viscous materials such as asphalt or mixtures thereof of the type wherein dies both above and below the molds operate to compress material The purpose of the invention is to provide a machine which effects the granulation of the material during the period in which the charge overlies the mold thus reducing it to a uniform state so that it will gravitate into and completely and evenly fill the mold

PUMP M E FOSS Box 8 Wilder Minn Among the objects of the invention are to provide a double cylinder pump each cylinder of which is double acting thus providing what is in effect a quadruple acting pump fluid being drawn into the pump and ejected from each end of the barrel at each stroke of the plunger in each direction

REPRODUCER FOR TALKING MACHINES —W T LAKIN Long Md One of the foremost objects of the invention is to provide a reproducer having a balanced needle bar capable of lateral adjustment in the direction of vibration of the diaphragm to vary the pressure on the diaphragm and consequently alter the pitch A further object is to provide a reproducer having a balanced needle bar fulcrumed in the plane of the diaphragm

PRINTING PRESS —A ANDERSON Lincoln N J The primary object of the invention is to provide a mechanism for reciprocating the bed of a printing press It is a further object to so construct the mechanism that the bed is reciprocated by power which is supplied in a continuous rotary direction It is a still further object to so construct a device that the lateral or transverse braces of the bed frame as commonly constructed do not have to be changed.

CINEMATOGRAPHIC MACHINE E PLUMMI Turro Milanese Italy The invention especially relates to machines for films having several photographs on horizontal sets and provides the means for a step by step horizontal displacement of the car or slide said means serving also as a guide during the displacement of the car The machine serves both to obtain the photographs on the film and to project the film photographs on a screen

TURBINE.—F E K[illegible] 614 10th Ave Clinton Iowa The particular object of the invention is to provide a steam turbine having a construction of rotor in which the steam is admitted axially then directed radially and then circumferentially in contact with the blades or vanes in a circular series so as to utilize the full kinetic energy of the steam in its passage in order to impart motion to the rotor A further object is to provide an arrangement of governors and valves for automatically obstructing the passage of steam in starting the rotor

MANUFACTURE OF BRICKS —F BREITSCHNEIDER Raitz Moravia The invention relates to a device for molding solid or hollow bricks from plastic material especially chamotte The process renders it possible to produce bricks of uniform shape and dimensions with level surfaces exactly corresponding to the mold the possibility of expansion or distortion of the surfaces after removal from the press being eliminated

CUTTER BLADE GRINDER —C F ROBBINS 17 Taylor St. Keene, N H An object of the invention is to provide a machine which is especially designed for grinding cutter blades of irregular shape such as are used in the woodwork in art where the cutters must be of an exact shape and ground repeatedly without altering the shape. A further object is to provide a machine which will grind blades of reverse shape that is, blades which are designed for use as right and left cutters

CLOCK ESCAPEMENT —H C SAUL, Douglas Wyo. The invention has for its object to provide a clock escapement so arranged that a smooth and accurate operation of the parts will result and friction be reduced to a minimum The invention is characterized by a novel device functioning imparting impulses to the pendulum in response to the operations of the scape wheel. More especially the invention embodies means to adjust the impulse device to regulate its engagement with the scape wheel and means to manually vary the amplitude of movements of the pallet

PROCESS OF RENDERING FATS AND OILS. —C F KAMRATH Box 891 Denver Colo. An object of the invention is to provide a process by means of which fats or oils may be so rendered as to effect a neutral product at the same time eliminating much work that is ordinarily required A further object is to provide a means by which the rendering is conducted at a low temperature and simultaneously with the removal of moisture by evaporation under a vacuum

AUTOMATIC BALL MILL FEEDER —H H BURHANS 11 So. 14th Ave Mt. Vernon N Y The invention relates to a rotary crushing or grinding device and a motor for driving the same, a feeder connected with the device for delivering material to be ground and means actuated by variations of power consumed in the motor independent of the motor speed for automatically varying the quantity of the feed

TUFT YARN SPRING CLIP —A T THOMPSON Rogers Ave Hightstown N J This invention relates more particularly to looms for weaving tufted fabrics such as tapestry and particularly Axminster rugs. An object is to provide means for permanently securing the springs in position adapted to be used in conjunction with the end members of the tuft yarn frame bar and prevent them from working loose during the operation of the loom A further object is to provide a spring which requires no extra attaching parts or guards being a complete spring in itself

Medical Devices

CLASP FOR TEETH E R NEHRING 8 Windsor St Woodhaven L I N Y The invention relates to dental appliances Among the objects is to provide means for attaching artificial teeth to natural teeth It is a further object to provide means by which the artificial teeth may be removably secured to the natural teeth The device comprises an enlarged body portion provided with an opening and a reduced tongue projecting from the body portion

DENTAL COTTON HOLDER AND WASTE RECEIVER N T WOOLSEY 408 Elliott Ave. Tottenville S I N Y An object of the invention is to provide a cotton holder and waste receiver more specially designed for use by dentists arranged to enable the dentist to keep a supply of bunched dental cotton on hand for a day's work and to permit of readily disposing of the soiled cotton without exposing either the dental cotton or the waste A further object is to keep the cotton in a sanitary condition prior to use

Musical Devices

SHEET TURNER —W A LUCKE General Delivery Albany N Y The object of the invention is to provide a device more particularly adapted for use in connection with instruments of various types by means of which it is possible for the operator to effect a turning of a sheet of music without any delay and confusion A further object is to construct a device which shall be practically automatic in that it will be necessary for a performer to exert a minimum of effort to effect a turning of the sheet.

PIANISSIMO DEVICE FOR GRAND PIANOS. —J A HUMSEY 25 Lisle St East Braintree, Mass. The object of this invention is to reduce the hammer stroke without changing the position of the key to so construct the pianissimo mechanism that it can easily be applied to any standard make of action to provide a device in which a normally inclined thrust rod is arranged for movement into upright position between a key and an action support to move the latter toward the strings, and to make a simple and durable device.

Prime Movers and Their Accessories

INTERNAL COMBUSTION ENGINE.—L. B JOYNER c/o L. S. Haas 204 S Main St., Chicago, Ill. An object of this invention is to provide a device with means for cooling the pistons and parts associated therewith and for reciprocating the pistons with the cylinders. Air chambers are carried by the water supply pipes and serve to reduce the noise occasioned by the rush of the cooling fluid through the fluid-conducting passages.

SIGHT FEED DEVICE —O C NORTON Roodhouse Ill This invention has for its object to provide a device of the character specified adapted for use with internal combustion engines to feed water to the manifold wherein the amount of water fed is under observation and can be easily regulated to the required amount. The device is

also adapted for use as a primer for use on cold mornings, when the motor usually starts with difficulty

CARBURETER.—W Ashworth, 9 Hoosac St., North Adams, Mass. Among the objects of the invention is to provide a carbureter including a venturi, comprising two annular sections fitted together, each of the sections being formed with air by-passes, and means for automatically moving one of said sections with respect to the second for the same for aligning the air by-passes and regulating the passage of air through the same in direct ratio to the speed of the engine with which the carbureter is associated.

Railways and Their Accessories

TRACK.—G H Pifer, c/o Anthracite Motor Sales Co. 240 W Broad St. Hazelton, Pa. The invention relates to railway track construction for roadbeds and more particularly to track rails adapted for light-gaged railways or otherwise and to replace the heavy and expensive rolled rails, and the usual toy rails and coupling means, while also permitting and facilitating bending of the rail sections and the retention thereof in any desired angular or bent position.

HIGHWAY FOR GRADE CROSSINGS.—E. W Carter, 130 E. Crocket St. San Antonio, Texas. The purpose of the invention is to provide a highway for grade crossings which compels the drivers of vehicles to display the necessary caution when approaching a grade crossing, and permits the clear getaway of the vehicle only after they have actually crossed the rail track, the vehicle being compelled to slow down and to travel in a tortuous roadway before reaching the track.

SAFETY APPARATUS FOR TRAINS OR CARS.—W O Batts, Wilmot, Kan. A purpose of the invention is to provide an apparatus designed to be associated with the wheel trucks of a car and the air brake system and which operates when the train or car is derailed to effect actuation of the air brakes to stop the train, and which supports the train or car in such manner that the car wheels will be clear of the railway ties to prevent bumping thereon with the attendant destruction or possible overturning of the car

RAILWAY TIE AND RAIL FASTENER.—C. E. Estabrook Springport, Ind. Among the objects of the invention is to provide a railway tie and fastener of simple, inexpensive and durable construction which is capable of being easily adjusted to support the rails of tracks of different gages, and which is so constructed as to be adaptable to various kinds of ballast, rail, or rolling stock, and which will effectively secure the rails against lateral displacement.

SAFETY DEVICE FOR THROTTLES.—W W Sykes, 926 Bainbridge St., South Richmond, Va. The invention relates more particularly to safety device applicable to moving vehicles employing air brakes, the object being the provision of means whereby the operator will be notified when the pressure in the main reservoir of the air brakes falls below the required pressure for proper running The invention aims to provide means which will positively signal the operator of the locomotive when the vehicle is either in motion or stationary

VENT VALVE.—J Ulrich, 1125a So. Taylor Ave., St. Louis, Mo. Among the objects of the invention is to provide an attachment to be applied to the conventional check valve included in the air-brake system of railway engines. The invention is adapted to be associated with the system in such manner that when the check valve is moved against its seat an automatic vent valve is opened and permits the escape of any back pressure which might be built up in the line and prevent the proper releasing of the brakes.

EXTENSION STEP.—A. E. Sebert Frankfort, Mich. An important object is to provide a railway extension step which may be readily and conveniently thrown to its operative position when desired and which when in its inoperative position does not protrude to any objectionable extent. The invention aims also to provide an extension step which is automatically lowered when the trap door of the step is elevated and which may be disconnected from the step when desired.

Pertaining to Recreation

AMUSEMENT APPARATUS.—F R Creston, 1160 No. Wanamassa Ave. Asbury Park, N J Among the objects of the invention is to provide an apparatus designed for use in pleasure resorts, fairs, exhibitions and other places of amusement, and arranged to require considerable skill on the part of the player to successfully actuate the apparatus in the shortest time to win the game, and to give each player practically the same chance of winning The device consists of an apparatus comprising fragile inflatable objects and pressure means for inflating said objects to burst them.

BALL GAME APPARATUS.—W G. Jackson, Pompton Lakes, N J This invention relates to an apparatus for playing games by the use of balls to be thrown at targets for the scoring of points, and more particularly relates to an apparatus of the indicated character adapted to variously display signals in accordance with the hits made.

Pertaining to Vehicles

MUD GUARD.—F W Simons, Jr., 428 W 34th St., New York, N Y The general object of the invention is to provide a device which may be readily applied to a wheel of an automobile or other vehicle at the outside for preventing the wheel from splashing mud and water on pedestrians or objects at the side. A further object is to provide a device which may be suspended at the side of the wheel and restrained from turning with the wheel.

BRAKE ATTACHMENT FOR AUTOMOBILES.—F R. Peterson 1414 Mallon Ave., Spokane, Wash. The invention has reference more particularly to an attachment to connect the service brake pedal of a Ford automobile with the clutch operating arm of the usual transverse controller shaft, which is usually operated by a hand lever and which also acts to apply the emergency brakes located in the drums of the rear wheels.

REAR-END AUTOMOBILE SIGNAL.—G. G. Morin, 74 Hampden St., Holyoke, Mass. This invention has for an object the provision of a construction which will automatically operate when the controlling members of the automobile are operated for producing proper signals at the rear of the automobile according to the particular levers operated, and will present a signal having a legend thereon, a light and a sound.

TRANSMISSION GEARING.—R. D. Grose, 4341 Tracy Ave. Kansas City Missouri. The object of the invention is to provide a transmission gearing especially adapted for use with tractors which provides for an efficient transmission of the motion at all engine speeds, which is of simple and durable construction and which may be easily and readily operated to vary the speed and direction of the transmission of the motion.

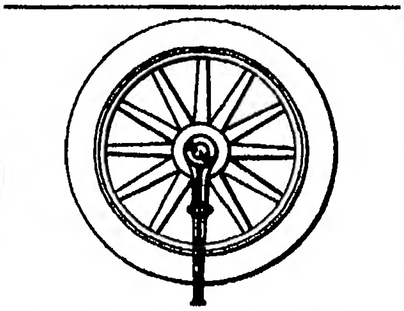


Fig. 9.—An automobile wheel lock which prevents the theft of the car, invented by Rena Lawrence, San Francisco, Calif

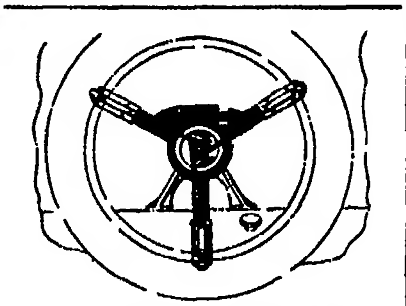


Fig. 10.—A combined tire carrier and rim spreader invented by O. C. Schlenker, of Bovina, Texas

ANTISKIDDING DEVICE.—T V Elliott, 812 Denison St., New Brunswick, N J The device is intended for use on wheels of automobiles, auto trucks and other vehicles, the object is to permit of conveniently and quickly placing the device in position on the wheel to prevent skidding, or to allow of quick removal whenever it is desired for repair in case of damage. A further object is to provide a device which is durable, and cheap to manufacture.

TOWING DEVICE.—M T Waterman, 606 Third Avenue, East, Cedar Rapids, Iowa. The invention particularly relates to coupling means for connecting a pair of motorcycles of the side car type, so that a stalled motor car can be readily towed A further object is to provide a device which can be conveniently carried from place to place, and which will maintain the motorcycles spaced a relative distance apart and efficiently perform its functions whether going up grade or down.

COMBINED TIRE CARRIER AND RIM SPREADER AND CONSTRICTOR.—O C. Schlenker, Bovina, Texas. The purpose of the invention is to provide a device adapted to be attached preferably to the rear of a motor vehicle which is capable of performing the double function of carrying a spare tire and rim and spreading and constricting the rim to effect the application and removal of the tire to or from the rim. (See Fig. 10.)

ATTACHMENT FOR CRANK SHAFTS.—W W Yarbrough, Box 2435 De Soto Station, Memphis, Tenn. The object of the invention is to provide an attachment of the character specified adapted for use with the crank shafts of motor vehicles for receiving end thrusts and for removing the strain from the main bearing produced by the clutch spring, to retain the magneto in good order and to obviate the necessity of spinning the crank to start the motor.

ILLUMINATED SIGN.—J H. Emily, [illegible] Frerot St., New Orleans, La. The purpose of the invention is to provide a sign particularly adapted, although not necessarily, for use on motor vehicles and in such manner as to be prominently displayed and illuminated by lamps which are connected to the lighting circuit of the vehicle. A further purpose is to provide a simple and inexpensive construction with means for detachably supporting the same.

STEERING WHEEL LOCK.—R. T. Binder, 221 Halsey Street, Newark, N J. The inventor has been granted two patents of a similar nature, their object being to provide a steering wheel lock which will enable the user to lock the steering wheel against rotation and against removal, and make it practically impossible for unauthorized persons to free the locked parts, the locking parts being so concealed as to prevent their mutilation.

MOTOR VEHICLE.—E. B. Jackson, 30 East Jackson Street, Wilkes-Barre, Pa. The invention has for its object to provide a vehicle wherein the two wheels which support the vehicle are in line in the same manner as a bicycle, with an enclosed body on the lines of an automobile, and wherein means are provided for steering the vehicle and controlling the motor operable from the seat in the body, and means for supporting the body in upright position when not in motion or moving slowly

WHEEL LOCK.—Rena E. Lawrence, 1087 Market St., San Francisco, Cal. The primary object of the invention is to provide an automobile wheel lock which will prevent unauthorized removal of the wheel and also act as an obstruction to prevent normal rotation of the wheel, the locking device being made fast to a spoke and the hub, one end being extended beyond the rim whereby readily traceable marks will be made in the road accompanied by a noticeable "bumping noise" as the car travels. (See Fig. 9)

SHOCK ABSORBER.—P F Halferty, Aberdeen, Wash. The invention relates more particularly to shock absorbers of the snubber type for use on automobiles and other similar vehicles, an object being to provide means for utilizing air pressure or partial vacuum and also spring pressure to absorb shocks and jars. The device is relatively small and can be conveniently attached to the frame or chassis of an automobile.

STAKE.—E. Olson, 111 2nd Ave. So., Great Falls, Mont. An object of the invention is to provide a wagon body stake which carries a spring actuated locking means for automatically locking the stake in a pocket, thus obviating the very common inconvenience caused by the stake jolting out when traveling over rough roads. A further object is to provide a self-locking stake which will be strong and durable, and comparatively inexpensive to manufacture.

BICYCLE STAND OR SUPPORT.—A. Denan, 161 Gold St., Brooklyn, N Y The primary object of the invention is to provide a stand for bicycles, motorcycles and the like which is automatically held or retained in its inoperative position A further object is to provide a device which when in its operative position will automatically move to the inoperative position when the weight thereon is relieved. The device may be attached without change to bicycles or motorcycles of standard designs.

TIRE PUMP.—F Hjerth, R.F.D. No. 2, Marina, Iowa. This invention relates particularly, although not necessarily, to hand-operated tire pumps, a purpose being the provision of an air pump in which the intake and expulsion of air occurs at each stroke of the piston, whereby the pumping capacity of the pump is doubled as compared to that of the ordinary pump.

APPARATUS FOR THROWING THE WHEELS INTO AND OUT OF ACTION OF A VEHICLE HAVING BOTH WHEELS AND ENDLESS TRACKS.—E. [illegible], 13 Rue de la Rochefoucauld, Paris, France. The invention provides a construction of apparatus in an automobile or other vehicle, having wheels and endless tracks and capable of drawing directly or by towage, or of carrying a load over any kind of ground, whereby either of these two methods of progression may be brought into use at will, one being suitable for roads and permitting of rapid speed, the other being suitable for various kinds of ground to be traversed away from roads.

CLASP.—O. Gunnels, Meyers Falls, Wash.—The invention relates to a fastening element in the nature of a clasp, which is primarily adapted for use in connection with anti-skid chains, and by means of which an element will be provided which will permit of an instantaneous association of the anti-skid member with the wheel, and prevent any accidental detachment thereof, although permitting of its being wilfully accomplished.

JACK.—H. A. Thornburg, 205 No. Main St., Orlando, Fla. The object of this invention is to provide a device of the character specified, especially adapted for use with motor vehicles, and to be attached permanently in place on the axles, and to be normally out of operative position, but capable of being brought into operation when desired, merely by the movement of the jack in its normal operation.

RESILIENT WHEEL.—A. Nin y Martinez, P O. Box 665, San Juan, Porto Rico. An object of this invention is to provide a construction wherein resiliency is secured through the use of compressed air operating at the end of reciprocating spokes. Another object is to provide a comparatively stiff rim having hinged spokes and means associated with the hub which will take up the shocks and resiliently limit the swinging movement of the spokes and the movement of the rim.

AUTO TREADMILL.—C. E. Anderson, 814 2nd Ave., Superior, Wis. Among the objects of the invention is to provide a treadmill on which an automobile can be conveniently run so as to position the drive wheels in frictional engagement with pulleys for generating power which may be utilized for any desired purpose. A further object is to provide a device which can be readily moved from place to place.

Designs

DESIGN FOR A COLLAR FASTENER.—S. L. Gedney, 25 Clinton Ave., Maplewood, N J

DESIGN FOR A SIFTER TOP RECEPTACLE.—M. Wolf, 1156 Trenton Ave., Bronx, New York.

DESIGN FOR A LAMP.—C. W La Roche, 2432 W York St., Philadelphia, Pa.

DESIGN FOR A HANDLE.—P M. Marko, 1408 Atlantic Ave., Brooklyn, N Y

DESIGN FOR LACE.—H. Binch, 106 5th Ave., New York, N. Y

DESIGN FOR AN UMBRELLA AND PARASOL TIP.—B. O Wright, 91 Fifth Ave., New York, N Y

DESIGN FOR A PIN.—M Manfredy, 1350 Forty-third Street, Brooklyn, N Y.

DESIGN FOR A STORAGE BATTERY TERMINAL.—P M. Marko, 1408 Atlantic Avenue, Brooklyn, N. Y

DESIGN FOR A STAND.—J D. Holmes, 815 Fourth Avenue, New York, N. Y

DESIGN FOR A HANDKERCHIEF.—C. L. Sumner, care The William Sumner Co., 926 Broadway, Tacoma, Wash.

DESIGN FOR A BAG FRAME.—E. Norman, 390 East 159th Street, Bronx, N Y

DESIGN FOR AN ELECTRIC IRON.—A. Ruellans, 66 E. 79th St., New York, N. Y

DESIGN FOR A ROSARY.—G. Thibault, Whitehall, N Y

DESIGN FOR A REFLECTOR.—E. Ziegenmann, Jr., P. O. Box 142, Hudson Heights, N. J.

Miscellaneous Notes

Baby Travels by Air.—The first baby in arms to patronize the Continental airways left the London Air Station for Paris on the 12.30 airplane express recently

New French Coins.—Bronzed aluminum coins to the value of 50,000 000 francs are being distributed by the Bank of France to replace paper money condemned as unsanitary

For the Lazy Bather.—A novel sea-bathing accessory is in the form of an easy chair made of the cork-like balsa wood in which the bather lounges half-submerged while reading, smoking or chatting.

Light, Airy Blocks.—Instead of building in city-block style, a contractor is turning each house at an angle of 45 degrees giving the block a saw-tooth façade and admitting light and air from four directions.

Human Flies in Rome.—Our students at the American Academy are scaling the Trajan Column and crawling over the rotunda of the Pantheon they are studying measuring and drawing the details of these masterpieces.

Reconstruction's Progress.—Ninety per cent of the devastated area in France is now restored to cultivation; half the destroyed manufactories have been reopened, and 90 per cent of the damaged railway lines are again in use.

Dogs and Horses as Food.—In the second quarter of 1919 the meat of 9642 dogs was passed upon by inspectors of the German imperial slaughter houses; horse meat also was in great demand, and the number of horses slaughtered for food was double that of peace time

British Competition in Bolivia is placing American goods at a great disadvantage A British company is misinforming the country in favor of English-made goods, and is forcing customers to buy any American goods through Liverpool thus doubling the freight

President Harding's Finger Prints.—Delegates of the International Association for Identification recently convening at Washington persuaded President Harding to be finger-printed for their records. The Association seeks the registration of all Americans, the records to be kept at post offices.

Swiss Watches Not Wanted.—Largely because Americans are now buying their native product the Swiss watchmaking industry is in the doldrums and has despairingly appealed to the government for a subsidy 32 000 watchmakers are idle in spite of the fact that watches are being offered at practically cost price.

Rubber Production Falls.—In parts of Brazil plantations have been abandoned and rubber manufacture reduced almost to zero Some of the rubber land is being planted to cotton a little is being worked barely enough to keep paths open between the trees It means practically no rubber from this territory for the fiscal year ending April 1922

Meteors and Forest Fires. France has been suffering from forest fires of mysterious origin the careless cigarette smoker has been blamed but foresters and some meteorologists now incline to the belief that falling meteors were the cause In one flame-swept area of a thousand acres were found great meteoric fragments still hot three days after the fire

Two Wonderful Books.— The casual observer might see nothing especially remarkable in two books exhibited by the Smithsonian Institution yet they are unique in that they were written and made by one man the late Dard Hunter of Chillicothe Ohio. He manufactured the paper designed and cast the type set it up printed the volumes on a hand press, and bound them himself

Watches with Two Hour-Hands.—The latest fad is the timepiece with two hour-hands. The commuters started it, that they might have railroad time and daylight saving time before them at a glance but the girls with lovers in foreign parts are calling for watches that enable them to visualize what "he" is doing in London or elsewhere One such call was for a watch showing the time here and in Shanghai

Why Germany Can Undersell Us.—Using the mark as a basis of comparison of 2 300 000 German metal workers 63 per cent receive 8 times the wages of 1914 36 per cent from 5 to 8 times as much and the rest less than 5 times the 1914 wages. Since, in the same time the cost of living has increased 15 times, the actual wages are but from one-third to one-half those of 1914. No wonder German manufacturers can undersell the world.

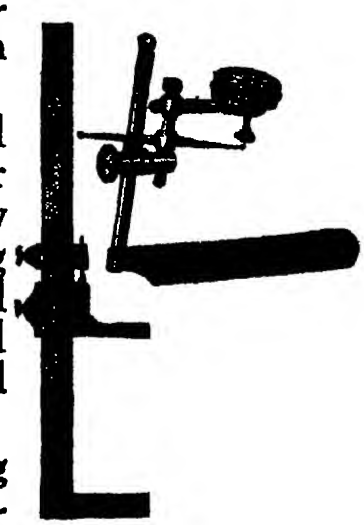
Farming in China.—For 4000 years Chinese methods have maintained the fertility of the soil. Despite obsolete equipment, China is probably after the United States, the foremost agricultural nation; intensive cultivation grows several crops on the same plot of ground The farmer generally owns his land, though the average farm is but an acre in extent. No less than 80 per cent of the foreign trade consists of agricultural and allied products.

Germany's Book Output.—The German literary mill ground out 32,345 books in 1920 an increase of 9681 since 1918. Political economy fell off from 3400 to 2898; art, music and the theater from 600 to 495; and military science from 348 to 176. Increases appear under theology, 1647 to 2008; philosophy, 914 to 960; medicine, 1072 to 1230; pedagogy [illegible] to [illegible] literature and linguistics 1062 to [illegible] history, [illegible] to 1208; [illegible] 1403 to [illegible] [illegible] 1818 to 1431. [illegible]

The difficulty of many a task is largely determined by the fitness of the tools with which the worker is equipped.

On this job, for example, the Starrett Universal Dial Test Indicator used with a Starrett Vernier Height Gage is enabling the machinist to quickly and easily set his boring bar for this exacting job. Without precision tools such as these, metal working operations within close limits could only be accomplished slowly, laboriously and inaccurately, if at all.

The latest Starrett Catalog No. 22 B, describing and illustrating 2100 time and labor saving Starrett Tools, will be sent free on request. Write for copy.



THE L. S. STARRETT COMPANY
The World's Greatest Toolmakers
Manufacturers of Hack Saws Unexcelled
ATHOL, MASS

Starrett Tools

SOME TOOLS USEFUL IN CONNECTION WITH DRILLING

Starrett Steel Drill Blocks and Clamp

Of case-hardened steel. May be used singly or in pairs, close together or separated and are kept in line by a spindle passing through friction bushings. The blocks are 1¼ inches square and will hold round stock to 1¼ inches diameter

Starrett Machinists' Center Punch

Of fine tool steel knurled, tempered ends and points carefully ground. Made in five sizes.

Starrett Time-Saver Tap and Drill Gage

Gage shows right sized drill to suit machine screw tap leaving just enough stock for tap to cut as near a full thread as is practicable for one tap without breaking Tested after hardening and warranted accurate.

Starrett Toolmakers' Steel Clamps

Made from drop forgings, case hardened Take-up blocks slip on and off end of screw A hole in the block permits the insertion of a screw so that clamp may be fastened to a bench and used as small vise

Starrett Improved Scriber

Points are made of fine grade steel well tempered Stock is knurled and nickeled and of sufficient size to be easily held without cramping or turning in the fingers. All parts are interchangeable.

Starrett Steel Rule

Made of light or heavy spring-tempered steel, flexible and semi-flexible, graduated in the English or Metric systems.

Starrett Toolmakers' Dividers

Made of round tool steel with legs drawn down making them hard and stiff The fulcrum nut is hardened bows made extra strong Made with solid nut only

Starrett Automatic Center Punch

A knurled adjustable screw cap working in conjunction with a spring regulates the stroke which may be light or heavy Made of tool steel carefully hardened with ground renewable points

Starrett Spacing Attachment for Center Punches

Designed for use with the Automatic Center Punches the locating point is on the principle of a spring plunger held in its lowest position by a light spiral spring The attachment has a capacity of from 1/16 inch to 1¾ inches.

Electrical Notes

Summaries and Excerpts from Current Periodicals

New York's Water Power Bill became law when Governor Miller of New York signed the Gibbs Water Power Bill providing for the leasing of the undeveloped water power of the State to private interests, under the supervision of the State. The measure was introduced in the Legislature by Senator Leonard W M Gibbs of Buffalo.

A New Direction Finder.—According to the *Electrical World*, a new method of finding direction has been developed by the engineers of the Marconi company The advantage claimed for this new method is that it is less seriously affected by the reflection and refraction phenomena which are usually known as night effect. The system consists of the well-known combination of the Bellini Tosi aerial and an open aerial adjusted to give a heart-shaped diagram with a single zero It is indicated that a receiver of this type may give very inaccurate results, but if the signals are so strong that the minimum is sharply defined there should be no difficulty

A High-Voltage Fuse.—The problem of fusing a high-voltage circuit is a difficult one to solve, for the reason that after the fuse blows through one cause or another the arc formed must be immediately extinguished to break the circuit. A recently-introduced high-voltage fuse consists of a fusible element held in tension by a spiral spring within a glass tube which is filled with a non-inflammable liquid of extremely high dielectric strength This liquid will not freeze in any climate the freezing point being lower than 65 deg below zero F A current greater than the fusing value of the fuse results in the melting of the fusible element, instantaneously releasing the spring which establishes a definite large gap This clearing of the circuit requires less than one cycle

The Toggle Switch.—The toggle or tumble switch long a favorite in Europe is slowly making its way into the best American homes, due to three reasons (1) Handsome appearance (2) simplicity of installation and operation (3) the fact that once installed they remain permanently fixed in position and require no further attention To introduce the toggle switch in this country radical changes over the European type of mechanism were necessary An instantaneous make and break had to be substituted for the slow make and break used abroad. A flip of the fingers or a movement of the elbow is all that is required to operate the toggle switch One American manufacturer has provided his toggle switches with a luminous tip so that they may be located in the dark.

Why Use the Arc System?—For unfailing regular communication by radio over long distances the arc system should be employed so we are informed by followers of this method of radio transmission Generating continuous waves, the arc system has all the advantages of Maximum power input to a given aerial system due to uniform electrical strains on the insulators, enabling a cheaper and smaller aerial system to be employed to transmit over a given distance, or increase of range of an existing station by substitution in place of a damped wave generator Greater selectivity in reception with consequent greater freedom from jamming and atmospheric disturbances thus rendering the service less liable to interruption Heterodyne reception giving improved signal strength and choice of audio-frequency to suit the operator with still further freedom from interruption.

Development of the Flashlight Battery.—In a recent paper dealing with flashlights and flashlight batteries, prepared by R. H. Mathews, we learn that the flashlight was invented in 1898 by David Misell, who also developed the first flashlight battery Great difficulty was experienced in marketing the early batteries due to their short life and lack of facilities and the unwillingness of lamp manufacturers to make miniature lamps with carbon filament taking 4 watts per horizontal candle-power The efficiency has been increased far beyond the expectations of the pioneers in flashlight manufacture. Over 500 patents have been allowed covering flashlights, hand lamps, and combinations involving flashlights. During the past year the business totalled $30 000,000. It is estimated that there are over 10 000 000 active users of flashlights in the United States, and that over 5 000,000 are sold annually Over 25 000 000 batteries are manufactured yearly for use in these flashlights.

Reversible Electric Valve Tube.—For some purposes where one-way electric valve tubes are used it would be desirable to reverse their valve action without any change in electric connections, we gather from *Elektrotechnische Zeitschrift* This has been made possible by a new valve tube designed by H. Greinacher of Germany The tube consists of a spherical glass bulb with two cylindrical ends, containing each a short lead-in wire Between the two cylindrical ends an aluminum tube, insulated from the two electrodes, is stretched Within this metal tube is a small aluminum ball If this construction is tilted to the left side, the ball rolls down to the left end and makes contact between the left lead-in wire and the tube so that in this position the [illegible] and cylindrical end by the [illegible] piece of wire [illegible] A slight tilt in the opposite direction causes the ball roll over to the other side, where the characteristic and valve of the tube will be reversed.

The Weston Standard Cell.—Invented by Edward Weston, Ph.D LL.D., and first exploited in 1892, the Weston Standard Cell rapidly supplanted the Clark and other preceding cells previously used for standardization purposes. For [illegible] years it has been considered the standard cell because of its constancy of voltage, negligible temperature coefficient error and its portability The Weston cell is made in two forms: (1) The Weston Normal Cell, which is a saturated form which has been adopted by the National Standardization Bureaus of the world as the standard of electromotive force, (2) The Weston Standard Cell (unsaturated form) which is recommended by National Bureau of Standards as a practical standard because it has no appreciable error due to temperature changes, whereas the normal cell or saturated form has a temperature coefficient which, though much less than that of any preceding form of cell must nevertheless be taken into consideration

The Negatron is a new form of vacuum tube which has made its appearance in England. The principle on which this device works is briefly as follows: A thermionic valve is arranged with two flat anodes, one on each side of a filament, according to *The Electrician* Each anode is connected through an anode battery to the filament so that the electrons emitted by the incandescent filament are distributed equally between the two anodes. A control electrode, *e.g.* a fine grid, is also arranged within the valve between the filament and one of the anodes. This latter anode is called the diversion anode while the first one is called the main anode. By suitably arranging the relationship between the electron emission and the anode voltages we may obtain a saturation effect. When the main anode voltage is increased the grid potential is increased, electrons are diverted from the main anode and the main anode current decreases. Hence the negative resistance effect. The main use of the negatron is as a generator of continuous oscillations for the transmission or reception of continuous waves.

Radio Central Progress.—By the time this is read the Radio Central wireless station at Rocky Point, Long Island, N Y some 60 miles east of New York City will probably be in operation. At the present writing the latter part of November news comes to us that two of the wings or spokes of the wheel-like arrangement of the antenna towers have been completed Twelve steel towers, each 400 feet high compose the two wings or one operating unit. The total distance between the first and the twelfth towers of the complete unit is approximately 3 miles. In the center of these twelve towers is the central power-house, which is now completed, and two of the 200-kw Alexanderson high frequency alternators have been installed and are ready for operation The receiving station designed to operate in connection with the Radio Central is at Riverhead L I about 17 miles away This receiving center is capable of intercepting six different messages simultaneously The control system is so arranged that there are no actual receiving operators present. The aerials pick up the signals, special apparatus in turn direct these to a regular land line and finally the messages are received in New York City A complete description together with a collection of photographs of the Radio Central station appears on page 8 in the present issue of this journal

Signalling by Invisible Rays.—Many months before the United States entered the war Dr Leigh Bell and Norman Marshall of Boston attacked the problem of evolving a suitable invisible ray signalling system. From a recent issue of *Electrical World* we learn that they met with success in utilizing ultra-violet rays and that their system was actually tried out at the front. In the past there have been several attempts to signal by rays normally invisible but all previous efforts had been either with the extreme ultra-violet, using the carbon or mercury arc or even sparks between metallic electrodes as a source, or else they had drifted toward the infra-red in the belief that the ultra-violet was so quickly absorbed by the atmosphere and so difficult to obtain in quantity as to be impracticable for [illegible] and even less attainable in [illegible] apparatus. As far as Messrs. Bell and Marshall could ascertain, every previous effort to utilize the ultra-violet had employed quartz apparatus, this, of course, being [illegible] production in quantity as required for military use. [illegible]

[illegible]

[illegible] Engineers in America. [illegible]. New York: The Ronald Press Company, 1920. 8vo. [illegible] pp.

Men of business and students of economics will have noticed the recent increase of works on [illegible] industries; unfortunately these are for the most part written either in highly technical [illegible] or in journalese. Professor Keir's volume avoids both extremes, addressing itself directly to a practical clientele. Thoroughly [illegible] industry [illegible] industries that supply it and make [illegible] and [illegible]. Among [illegible] general material, the chapters treat of [illegible], cotton, wool, leather, shoes and paper and [illegible] some effects and tendencies of our manufacturing practice.

Small Motors, Transformers, Electromagnets. By H. M. Stoller, B.E., M.S.; F. H. Austin, B.S., E.E.; and E. W. [illegible], M.E. Chicago: American Technical Society, 1921. 8vo. 230 pp. Illustrated.

By cutting theory to bare essentials the authors compress into one simply worded handbook three subjects of interest to engineer and amateur. The latest and best practice in the design of small motors is described with careful attention to detail and many types up to ½ horsepower are offered, including a starting motor and a charging generator for automobiles. The book also conveys accurate knowledge of the low tension transformer from 110 to 220 and down to the lower voltages and of the construction of transformers suitable for wireless. The work concludes with typical designs of electromagnets, carrying calculations through to final results; the material on induction coils includes a concise description of the Tesla coil.

Lessons in Mechanics. By William S. Franklin and Barry MacNutt. Bethlehem, Penn.: Franklin and Charles, 1919. 8vo. 221 pp. Illustrated.

This text is arranged to meet the needs of the two-year schedule in elementary physics recently adopted by some technical schools, and emphasis is placed upon "the mathematical bottom of the subject." Hence differential and integral calculus appear, though previous study of calculus is not demanded. The course brings mathematical and physical elements into close coöperation, facilitates classroom work, and leads each topic into illustrative problems.

The Engineering Draughtsman. By E. Howarth, A.M.I.E.E. New York: E. P. Dutton and Company. 8vo. 246 pp. 96 plates.

Many branches of engineering are represented in this course for students already in touch with elementary principles. Its method of instruction is by illustrative plates of machines augmented by a full clear explanatory text. Frequently sufficient information is supplied to enable the student to finish sets of working drawings covering such machines as the steam hammer, single ram pump, hydraulic press, oil pump, steam engine governor and lathe. Altogether there are more than 150 examples interestingly and lucidly presented, with tables of threads, keys, and decimal and metrical equivalents.

An Introduction to Science. By Bertha M. Clark, Ph.D. New York: American Book Company. 8vo. 494 pp. Illustrated.

Laboratory Manual for Introduction to Science. By Bertha M. Clark, Ph.D. New York: American Book Company. 8vo. Loose-leaf, 208 pp. Illustrated.

This introductory text and laboratory manual have been in use for several years and have proved successful in their aim of [illegible] interesting young high school students in their present, as well as better fitting them for the future. The [illegible] projects include [illegible] standards, fuels, lighting, labor-saving devices and hygienic items.

A Treatise on Reinforced Concrete. By [illegible]

[illegible]

Science Notes

A Digest of Everything of General Interest Appearing in Current Literature

The Saber-toothed Tiger, according to recent evidence, roamed the earth 200,000 years ago.

Scientific Congress.—The third Pan-American Scientific Congress will be held in Lima during July, 1922.

The Weevil and the Market.—The recent rise in the price of cotton has been directly traced to the ravages of the boll-weevil, which caused a shortage in the crops.

A Hardy Alligator Pear.—A hardy variety of avocado has been found in Ecuador, the fruit weighs as much as 18 ounces, and the tree will stand some frost.

Doubling the Life of Plants.—A Viennese botanist has been able to double the length of life in certain annuals by suppressing their blossoms. This was done by withholding moisture, oxygen and other necessary nourishment.

Peru Protects Her Relics.—Except by permission of the Peruvian government it is forbidden to disturb or export archaeological relics, instruments, mummies, or other remains of the ancient Inca and pre-Inca civilizations.

Bamboo.—It is now proposed to import bamboo from Chile, and establish this plant in California. The South American self-propagating species thrives equally as well in the drier, as the more humid, climates. It is an excellent cattle-food

The Secret of Eskimo Health.—The Eskimos are naturally one of the healthiest peoples in the world; why this should be so is not as yet apparent. The School of Hygiene of the Johns Hopkins University will send out an expedition next May to study dietetics and nutrition among the Eskimos.

A Monument to James Orton, the American explorer, has been erected on Esteves Island, Lake Titicaca, where he was buried, by a Vassar College alumnae committee Orton was professor of natural history in Vassar in 1869, and led several Amazon expeditions.

The Tsetse Fly and Big Game.—An investigation is under way in Rhodesia to determine the source of infection carried by the tsetse fly, which causes sleeping sickness. It is now suspected that the primary host of the blood parasite, known as a trypanosome, is to be found among the herds of wild antelopes and other big game

The "Laurentic" and Her Gold.—The *Laurentic*, sunk off Lough Swilly in 1917, went down with $25,000,000 in gold bullion, about half of which has been recovered. She lies at a depth that makes diving operations extremely difficult, and a diver likens her appearance to that of a long street of houses which has collapsed in the middle.

The Pitcher Plant.—It has been found that the digestive agency of the insect-eating plant, *Nepenthes*, is sterile when taken aseptically from the unopened pitcher But, according to *Nature*, it becomes more effective after exposure to bacterial invasion. This septic condition, together with the enzymes contained in the bodies of the captured insects, are presumed to cause digestion

Our Paper Mill in Siam.—A duplicate of the experimental paper plant with which the Bureau of Standards successfully produced paper from rice straw, banana tree stems and lalang grass was ordered by the Siamese government, and is now on its way It has a capacity of 1200 pounds a day, and will be used to supply the Siamese army with writing and printing paper

City of London Is Just a Mart.—The City of London (proper), bounded by municipal and parliamentary lines, is not a dwelling-place, but a vast market. In 1806 it had 21 000 inhabitants, to-day it has but 13,700 During business hours it is the humming hive of a million human bees, but night finds it deserted save for a garrison of caretakers.

Wild Life Investigations.—The Roosevelt Wild Life Forest Experiment Station at Syracuse, established by New York State as a memorial to Theodore Roosevelt, is pursuing field investigations in the 7000-acre Allegheny State Park, south of Buffalo. Birds and fishes are being studied there, and funds have been provided to remedy the present rather precarious status of the beaver in the Adirondacks A field party is also in the Yellowstone studying wild-life problems.

War Declared on the Rat.—In the hope of materially reducing our annual loss of $200,000,000 due to the depredations of rats, the Biological Survey is starting a great campaign in the eastern States and is asking the hearty cooperation of every householder We have already called attention to a similar campaign in the West, where convict labor was used in distributing poisoned bait over the fields; one farm that had to replant twice last year has this year a fine, promising stand of corn from one planting.

The Cause of Goitre.—Sodium iodide has been administered as a prophylactic in goitre with marked results. E. E. Hayhurst of the Ohio State Department of Health believes that lack of iodine in the body is a cause of goitre, and he warns us against the commercial practice of eliminating iodine from table salt. Although goitre is prevalent in salt-mine districts it is probable that time has materially changed the composition of these deposits, and as sodium iodide is freely soluble, it would be the first of the halogen compounds to disappear.

The First Medical School.—According to Greek legend, the founder of the first medical school was Chiron, the centaur. Aesculapius was the only one of his many pupils that excelled the master. He studied the curative properties of plants and the treatment of diseases and wounds. If we can believe Homer, the two sons of Aesculapius, Machaon and Podalyre, organized the first army medical corps, which functioned during the siege of Troy Greece made demi-gods of her scientists and doctors, and the Iliad remarks that a physician "is worth many men."

In Gorilla-Land.—Carl Akeley, sculptor and explorer, is now in the Belgian Congo to study the gorilla at close range. The women of the party will each carry a camera and a small Winchester. Mr Akeley was with Roosevelt in the African expedition of 1911. He hopes to obtain some worth-while scientific results for the American Museum of Natural History, to accumulate a series of striking photographs, and, best being with him, to bring back a gorilla family. Asked about trouble with natives, he declared savage man was much less terrifying than the civilized product.

St. Paul's Whispering Gallery.—Lord Rayleigh explained this phenomenon by the curvilinear propagation of sound; that is, the tendency of the waves to cling to the wall-surface of the dome and creep tangentially along it. Recent investigations seem to show that he was right in assuming that the waves travel in a comparatively narrow belt skirting the wall, the thickness of the belt decreasing with the wave-length, but that he was mistaken in holding that in this belt the intensity is maximum near the wall and decreases rapidly on receding from it. The experiments located alternate zones of intensity and comparative silence between the sound-source near the wall and the center of the dome space.

Excavations in Ascalon, which have already disclosed Herod's famous cloisters and a statue of the great ruler himself, may eventually clear up many of the ethnical, geographical and theological mysteries that cluster about the site. Ascalon, one of the five great cities of the Philistines, takes us back to the 15th century B. C., and discoveries have already yielded evidence of three prime civilizations, the Philistine, the Roman, and the Crusading. The Philistine culture presents alluring and baffling aspects, whence it came, whither it went, are questions awaiting more light. Fertile Ascalon is being buried by the sands of the sea unless this encroachment can be arrested the place will become a desert. Meanwhile further disclosures are awaited with tense interest.

Sensitiveness in the Sensitive Plant.—According to the Journal of the Botanical Laboratory of Pennsylvania, the propagation of stimuli in *Mimosa pudica* and *Biophytum sensitivum* is centered in the endodermis. It is stated that the concentration of oxylate of lime in these tissues is supposed to be associated with the phenomenon of sensitiveness, and that the sensibility of the plants was proportionate to the amount of crystals contained in the cells. Each crystal was found to be contained in an envelope of protoplasm, which latter were connected throughout the cells by threads of protoplasmic matter The analogy of these conductors for the transmission of stimuli, to the nervous system of animals, is interesting in view of recent theories which propose that plants have the germs of mind.

Psycho-Analyzing Alice.—Andre Tridon, who is the extension of Freud's shadow over America, has been saying a few words about Alice, of Alice-in-Wonderland fame. Alice, it seems, has grossly deceived us; she is, as her creator was, a dangerous paranoiac, and should not be allowed to play with nice little children. Tridon gives overwhelming arguments in proof of these assertions, their only weakness being that they apply with equal force to psychoanalysts themselves, and he leaves us with the impression that Lewis Carroll should have been placed in an asylum and deprived of pen and ink. The creator of Alice has passed on, but the Ouija board is very much with us; it would be delightful to have Lewis Carroll's candid opinion of the Wonderland created by Freud and Tridon.

Giants.—From *Nature* we learn of a recent meeting of the British Association, wherein it was brought out that the popular conception is untrue regarding power of giants and the magnificent types of masculinity which they are supposed to be. Statistics were presented to show that giants were relatively feeble, usually short lived, and, in the majority of cases, devoid of those features peculiar to masculinity. Gigantism was said to be identified with abnormal conditions of two small organs located at the base of the brain—the thyroid gland and the pituitary body. The over-activity of these, [illegible]

Mechanical Engineering

A Simple Preventive of Burst Pipes is to cover them with a good thickness of slag wool or other non-conductor. Various pipe-sections have been devised to alter their shape and permit the expansion of water without detriment but after the first expansion these become just as liable to future fracture as the ordinary pipes.

Pulley Analysis.—The manufacturer of a leading paper pulley is advertising the results of a recent engineering test made of three different pulleys paper cast-iron and wood. At 2 per cent belt slippage which was assumed to be the normal condition it was found that the paper pulley had 2½ times the transmitting capacity of the iron one. The advantage fell off at greater belt slips, as might be anticipated. In these tests the wood pulley showed up slightly better than the metal one.

Perforated Tape Control for Machinery.—A recent writer in *American Machinist* with the success of two such diverse bits of apparatus as the player piano and the monotype before him makes the suggestion that this principle is deserving of an effort to extend it more generally into machinery practice. He thinks that automatic lathes of all descriptions a particularly promising field for the innovation and points out that theoretically at least there is not the slightest limit to what the tape can constrain the machine to do.

The Deterioration of Rope used for power transmission is held to a minimum when the sheaves over which the line runs have a pulley diameter equal to at least 40 times the diameter of the rope for speeds of 4500 running feet per minute or of 27 times the rope diameter for speeds around 8000 feet. A 45-degree-angled V shaped groove is recommended as the best compromise between a shallow groove, which results in slippage and excessive wear and a very steep groove which grips the rope too well and on this account uses additional power because of the tendency for the rope to stick.

Valve Grinding on any sort of internal combustion engine would be robbed of its terrors by general adaptation to general use of a grinding outfit now made mostly if not altogether for use with the popular small automobile. A spindle fits into the hole on each valve tappet and these are all connected with a single operating handle. The operator works this handle back and forth in a horizontal plane and the motion is communicated to the valve tappets as a rotary one. When one valve is finished before the others it is removed entirely and the machine goes on with the remaining ones.

Lumber Waste for Fuel. Hog fuel consisting of sawdust, shavings ground-up edgings slabs and trimmings, etc is widely used throughout the northwestern lumber fields but only as an incidental and the disposal of this material is usually a charge against the mill. A central heating plant has now been erected in Tacoma designed especially for the burning of this fuel and with no provision for handling any other. The ultimate capacity will be taken care of by four vertical water tube boilers of 7500 square feet each. The fuel arrives on barges and is handled by a 5-ton clamshell bucket and a system of conveyors. Full details of this interesting installation appear in *Power* due November 15th.

Powdered Coal Preparing Machines are nothing new but one recently put out is perhaps rather novel in the manner in which it combines impact pulverization with air separation. The pulverized material is discharged by centrifugal force directly into a large separating chamber. An exhaust fan in the discharge duct leading from the separating chamber draws air at slow velocity through this chamber removing the fine coal and allowing the oversize to return to the machine for further pulverization. Adjustment as desired is possible by virtue of the fact that the air velocity through the chamber determines the line of fineness between the delivered product and that which goes back to the hammers.

Edison's Snow Remover. Winter brings back the old problem of snow removal and at a forum on Snow Removal in Cities held in the Engineering Societies Building it was pointed out that Edison turned his attention to this question 40 years ago. At that time he built a big truck carrying a steam engine and compressor. This going as fast as a horse could walk gathered the snow up in front passed it into the compressor and left it in its wake in the form of little blocks of ice taking up but one-tenth the room of the snow. While success attended his efforts, the undertaking was dropped in favor of other inventions. Mr Edison can not recall the horsepower of the engine or the size of the compressor but believes that a larger compressor would have given even better results.

Oil Coolers on Marine Turbines.—In the lubricating systems of small units filters not being used remarks *The Practical Engineer* it is important that means be provided for returning the circulating oil to the bearings at the appropriate temperatures. Passing the oil through a coiled tube contained within the sump tank has certain definite disadvantages. By far a better method is to provide a separate oil-cooling tank. This should be constructed like a steam condenser but with baffle plates to break up the oil stream and provide a more effective and extensive cooling surface. The water circulation through the oil cooler should be by pump and not by gravity or thermo-siphon, and the water pressure should always be less than that of the oil so that in the event of an internal leak the oil will merely escape, rather than being diluted with water.

Patents and Trade-Marks

General Principles, Current Comment, and Interesting Decisions

Trade-Marks Under the International Bureau.—Claims must be submitted to Habana through the U. S. Patent Office. The applicant provides the Office with a fee of $5 in lieu of an abstract of title, the Bureau's fee of $50 in international money order form, an electrotype not exceeding 10 centimeters in either direction, with 30 reproductions in color if color is a distinctive element, a statement of ownership and address, the number and date of United States registration, and a Spanish translation of the particular description of goods as stated in the certificate of registration.

Volume of Business in the Patent Office.—The business of the Patent Office for the last six months was the heaviest for any half year in its entire history. The receipts for applications for patents amounted to $45 605, as compared with $42 607, $37 143 and $31 563 for the first six months of the years 1920, 1919 and 1918. The receipts for applications for trade-marks totaled $8 369 in this time as compared with $7 940, $5 447 and $2 720 for the corresponding periods of 1920, 1919 and 1918. The gain in applications for patent received in the half yearly period just closed over the first six months of 1918 was 42¼ per cent, while the gain in trade-mark applications amounted to 124 per cent. In spite of the industrial depression the amount of business presented to the Patent Office in every branch has constantly increased since the year 1918 and in leaps and bounds. The demands upon the Patent Office are beyond any previous figures in its history, with no recession in sight, and are far in excess of the capacity of its limited and practically stationary force to properly handle.

Canadian Patents.—A report of the Canadian Commissioner of Patents recently published shows a very great increase in the number of applications filed for Letters Patent. During the fiscal year 1918 the patent applications filed numbered 8296; during the fiscal year 1920 the patent applications numbered 11 198, and for the fiscal year ending March 31, 1921, 13 446 patent applications were filed. The activity of inventors is a pretty good barometer of the industrial progress which is being made and the filing of a great number of patent applications is evidence of commercial growth. This is so, for each group of inventions is a step forward in the effort which is being made to make this a happier world, and patent applications would not be filed on the inventions unless a valuable return on the patent grants was reasonably anticipated. When considering the report it is very interesting to learn to what extent residents of the United States are patenting their inventions in Canada as a preliminary to the extension of their commercial enterprises in that country. During the last fiscal year 7744 patents were granted to residents of the United States as compared with 1645 patents which were granted to Canadian residents.

Presumption Against Infringement Because of Grant of Patent.—The Patent Office in passing upon an application for patent never takes into consideration the question of whether or not the subject-matter of that application infringes any existing and unexpired patent. The sole questions determined by the Patent Office are those of novelty, usefulness and operativeness, and patentability. Naturally a great many entirely valid patents are issued, the subject-matter of each of which may infringe one or more of the claims of an earlier and broader patent. However, from time to time the courts have held that the grant of a patent raises a presumption of non-infringement of the invention covered thereby, though of course such presumption may be rebutted by the actual fact of infringement. Frequently the inventor who does not understand the situation is of the opinion that because the Patent Office has granted him a patent he is free to make, use and vend the invention without liability for infringement. Despite the fact that the courts have at different times held that there is such a presumption of non-infringement owing to the issue of a patent, many prominent patent attorneys are of the opinion that there is no real warrant under our patent practice for such a holding. Nevertheless the Supreme Court of the United States itself (Hildreth vs. J. M. Mastoras, 51, October Term 1921, decided November 7, 1921) recently said: "The Circuit Court of Appeals held that the issuing of the Langer patent after the Dickinson patent raised the presumption of a patentable difference between that patent and the Dickinson patent and against infringement. It is not necessary for us however to discuss that question, for we think that whatever presumption against infringement may attach to the issuing of the second patent, if any, the evidence here is quite sufficient to overcome it."

Farmers' Trade-Marks.—Attention has recently been directed to the use and registration of trade-marks by farmers for their products. That such trade-marks are registrable has long been the practice. There are certain requirements, however, that must be met as in the case of other sorts of names used as trade-marks under the Federal trade-mark law. The farm name, for one thing, must be used by the farmer as a trade-mark on his products that he ships to points outside his own State; in other words, a commodity that moves in interstate commerce. It must be printed, stamped or otherwise attached to each parcel or to the wares. The Federal law makes no provision for the registering of names used as trade-marks on commodities that are shipped only within the State. Although it is thought advisable, it is not necessary that the names be arranged into any distinctive design. Under the trade-mark act of 1905 it was not possible to register a name that is merely geographical, or merely descriptive, or is merely a surname not displayed in some particular or distinctive manner. Such marks, however, can be registered under the act of 1920 if they have been in use by the applicant in interstate commerce for not less than one year. In this way Congress sought to give recognition to a common-law right in a name used as a trade-mark on the ground of its use. Officials of the Patent Office point out that the names of varieties of seeds or plants can not be trade-marked. For instance, a seed grower may develop a variety of watermelon which he chooses to call the "Excelsior" and to sell the seed as such. Even though the seed goes into interstate commerce its name can not be registered, and any buyer who reproduces that variety of seed can sell it under the same name. "Excelsior" is the name of the variety, it is pointed out, and no matter who produces it the seed is still of that kind, and can be offered for sale as such by any one producing it. This also applies to strains and breeds of livestock.

The Importance of Preserving a Trade-Mark Unchanged.—A trade-mark is, in fact, a trade signature, for in most cases the trade-mark is the only means by which a retail purchaser may identify the merchandise which is offered for sale. When this means for identifying the merchandise is changed, confusion often arises in the mind of the purchaser, and this is especially true when the merchandise is offered for sale in a foreign market. Of course, a manufacturer is not likely to change his label in what he may consider to be its important features, but that which may seem to be immaterial when considered by a group of men with more or less the same point of view is sometimes looked on as such a material change by other people under different conditions and in another environment that the merchandise on which the modified labels are used is not recognized as the merchandise which has built up a favorable reputation in the past. While one person when looking at a trade-mark label will be attracted by a particular feature, another person may overlook the said feature entirely, as his attention will be fixed on quite another feature shown on the label. Still another person will have fixed in his mind only the general arrangement as shown. It will therefore be seen that if the said features are altered or removed from the label, or if the general arrangement is changed, some of the manufacturer's customers may be confused when attempting to purchase goods similar to those previously used. Not only is the above true with reference to the difficulty of the retail public in recognizing the trade-mark label when altered, but very often a material change in a trade-mark label raises a question of trade-mark infringement. In many cases a change is made which removes the only feature which distinguishes the trade-mark from a label used by a competitor, and sometimes the rearrangement of the features on a label, or the inclusion of a new feature, so changes the trade-mark as a whole that it so closely resembles the label of a competitor that confusion is sure to arise. There is still another reason why trade-mark labels should not be altered when a manufacturer is offering his goods for sale in foreign countries, for a public unfamiliar with the English language will often fix its attention on a word or other feature which is relatively unimportant to one acquainted with our language and environment, but which, because of some resemblance or suggestion to a foreign word or situation, is perhaps the only feature which will readily remain fixed in a foreigner's mind. It is also necessary to consider the fact that in some of the foreign countries the laws require that a trade-mark be used in the exact form in which it is registered.

Condition of Patent Office Work.—The serious condition of the work of the Patent Office was recently pointed out by Commissioner Robertson in a statement showing that the arrears of work in the Office have increased from 15 000 applications two years ago to more than 50 000 applications at the present time, the Office running behind about 400 applications a week. This situation is due to the very large increase in the work of the Patent Office and the numerical inadequacy of the Patent Office personnel, which, in turn, can be very largely ascribed to the insufficient pay under the present law. Obviously highly trained and specialized workers, such as Patent Office Examiners, can do far better for themselves by leaving the Patent Office and entering private practice. The result of the existing conditions is that in about [illegible] years the Patent Office has lost [illegible] of the [illegible] force [illegible]. The [illegible] [illegible] because a [illegible]

Notes and Queries

The Notes and Queries column is maintained for the benefit of our readers who desire information on subjects germane to the scope of the paper together with technical formulas and similar information. Matters requiring profound research or searches in a library cannot be undertaken. In connection with Notes and Queries proper we maintain a "Service Bureau" which is able in nearly all cases to supply addresses of manufacturers whose articles have sufficient novelty and merit to be illustrated in the news pages of this periodical. Correspondents are requested to write their inquiries in all cases making the subject of the letter entirely separate from the correspondence relating to patents subscription books etc. This will greatly facilitate the answering of these questions which in many cases have to be referred to experts. The full name and address should always be given. Our full "Hints to Correspondents" will be gladly mailed on request. All letters are answered by mail and only a very few of them can be printed in the limited space at our disposal.

(14879) W A R asks At some time in the near past, while reading a scientific magazine I saw where a number of scientists had taken a quantity of platinum one pound if I remember correctly and had stretched it into wire 1800 miles long. It was so thin as to be almost invisible, and to prevent breaking it was covered with gold. I told this to the class but was ridiculed for what they thought an absurd statement. Will you verify the above statement? or will you, if it is untrue tell me what is the greatest length to which one pound of standard platinum can be stretched. A Platinum wire has been drawn so fine as to be invisible excepting when held in strong light. The light reflected from it could be seen. It was not drawn quite in the manner you describe. Nor do we suppose a pound of it was ever made. It is used in the eye pieces of telescopes for the cross wires to locate the line of collimation through the center of the field. This wire was made by drawing the platinum directly by the draw plate till it was as thin as it would hold. This fine wire was then plated with silver by electroplating and the compound wire was then drawn to the limit of its strength. After this the silver was dissolved off by nitric acid leaving the platinum wire as we have described it. It could still sustain several grains.

(14880) N L T *asks for a rubber rust protector.* A A solution of pure unvulcanized rubber in benzine has been used for years as a coating for steel iron and lead and has been found a simple means of keeping them from oxidizing. It can be easily applied with a brush and it is as easily rubbed off. It should be made about the consistency of cream.

(14881) A A H asks Can you give me principal dates of the invention of the cycle which I need for a paper that I am preparing? A Four-wheeled velocipede invented in France by Blanchard and Magurier in 1779 pedals applied to a tricycle by a Dumfriesshire blacksmith McMillan 1834 rubber tyres for iron 1868 bicycles made in England by Coventry Sewing Machine Co. 1869 improved by J K Starley 1874 Starley's "Rover" with nearly equal wheels 1885 first C club in world Pickwick Bicycle Club fd in London 1870 Cyclists Touring Club 1878 cycles first manufactured in America by A A Pope, 1878.

(14882) J E K says I would be greatly obliged if you can afford me details of an experiment performed in England. A chemist asserted the success of the experiment which had to do with demonstration of theory of the ultimate composition of matter and declared it a widely known fact that under the influence of radioactivity gold had successively been degraded through lead, iron etc to hydrogen and then into negative ions and finally into intangibility. A. We have not noticed, even in the daily newspapers any such announcement of the transmutation of metals as you describe much less in the scientific papers. Had it taken place we can but believe it would have had large headlines in all the papers. We wait for further particulars, and mark the item Interesting if true. Now the electron theory upon which this story is based considers the electron to be the unit of the material of the universe, and that of it all things consist. The hydrogen atom contains about 1000 electrons. Other elements contain more in proportion to their atomic weights. Oxygen has 16 times as many or 16 000 and uranium has 238,000 of these particles in its atoms. Now radium has been known to give off particles which become helium. There are other evidences that there is a foundation for the belief held by many scientists that the various elements are thus related to each other and it is possible that hydrogen is the original "stuff" out of which the universe was built. But we do not believe that any man has unscrambled the universe in the manner which you describe. The last step is inconceivable. When everything had been evolved backward into hydrogen, it is unthinkable that this mass of hydrogen would by a wave of the wand be made to pass into nothingness.

Recent Advance in Lighting

(Continued from page 67)

mirrors and reflect images of light-sources into the visual field even though the sources are hung high.

In the design of fixtures for stores, offices, and similar fields there has been a strong tendency toward dust-proof fixtures. As a result a number of fixtures are available with enclosing glassware of ingenious design. They possess clear and diffusing areas properly located so that the lamp is screened from view but there are clear areas for the emission of light. Such units, if well designed are more efficient than a mere enclosing globe of diffusing glass. Installations of such units have widely multiplied during the past few years illustrating the rapid advances in lighting. In the design of such a fixture it is also aimed to have the clear areas in such a position that dust cannot easily settle upon them. Attention is also given to the design of ventilated fixtures in order that they may not be dust-traps. The importance of dust-proof fixtures is apparent when it is realised that the output of a lighting installation in an average location may decrease 25 per cent if not cleaned for a few weeks.

Ten years ago, if one lived in the country out of reach of electric service as most farmers did the acetylene plant was the only isolated lighting plant available. During the past few years a number of country-home electric-lighting plants have been developed. These generally consist of a gas-engine an electric generator and a storage battery. These plants have been very widely installed during the past few years and have reached beyond the frontier as far as Kodiak Island, Alaska. What cheer science has brought to those long winter nights!

The number of outlets in the modern electrical home has greatly increased recently. A few years ago wall-switches and convenience outlets were rare. In fact, in any large city today there is only about one base-board outlet per residence on the average. Today the middle-class home is not properly wired without 15 to 30 such outlets.

There is still a tendency among fixture manufacturers to use unshaded frosted lamps or glassware which is insufficiently diffusing. Glare is the result, and as the public becomes acquainted with the finer things in lighting it demands subdued light-sources.

With the advent of the modern tungsten lamps it has become possible to produce accurate artificial daylight of sufficiently high efficiency to be practicable. Of course science hopes for the day to come when daylight quality will be produced directly by the light-source, but until that day arrives the modern color-matching units will do the work required. Now accurate artificial noon sunlight and north skylight are available through the development of glass color-filters. Such units have been widely installed where accurate color-discrimination is necessary. The public finds them in stores where merchandise can be examined as to color without going to a door or window but the layman little realises that Liberty bonds are examined under them, that dyers depend upon them when dyeing millions of dollars worth of textiles, that the artist paints under them, that cigars are sorted under them and that they are serving in hundreds of other ways.

Color is gradually coming into its own in lighting as it has long ago in other fields, but owing to the lack of lighting artists it is not generally used in the best manner. With the advent of the gas-filled tungsten lamp it is now possible to obtain colored light of adequate intensities; however the lamp colorings which were satisfactory for the vacuum lamp do not withstand the heat of the gas-filled bulb. Only recently have superficial colorings been developed for this purpose; therefore various colored media have been devised as accessories. Colored glass plates and caps, also colored gelatines are now being used in show windows to obtain colored light. In the larger moving-picture theaters spectacular effects of colored light are to be seen. Much can be done by the lighting artist who understands what might be termed the language of color.

Colors have many psychological influences which can be utilised. A theater in the summertime seems cooler if illuminated by blue-green light instead of ordinary light. Conversely a warm tint such as that of the candle-flame, makes an interior more cheerful except in very hot weather. It is beginning to dawn upon users of light that light is an expressive medium of great potentiality. It can produce a certain mood in a room which can be altered instantly by switches. This realisation is evidenced in modern homes, restaurants, theaters, show-windows and many other places by the many lighting effects which are installed.

It is interesting to note that in many of the elaborate signs of the great white ways the lamps of low wattages are rapidly being replaced by large gas-filled tungsten lamps. Many signs which were designed for 10-watt lamps now contain 75-watt lamps. This is evidence that light is gaining in prestige even in advertising. No better indication of the widening interest in lighting is available than that of lighting legislation. Until recently laws contained at best only meager and incidental references to lighting. Today several states have separate codes pertaining to factory, school and emergency lighting and there are many laws pertaining to automobile headlights. These codes show that proper and adequate lighting is a great factor in the prevention of [illegible] and in the [illegible] of [illegible]. [illegible] are [illegible] a lower rate of insurance in factories which are well lighted, for as one of the insurance experts has put it: "during a [illegible] period in this country the number of accidents due to inadequate or improper lighting exceeds the yearly rate of our casualties in the recent war." Owing to the lack of proper and adequate lighting over 1[illegible] 000 men are continually absent from work in this country owing to disability. Thus it is seen that even though science contributes much toward the production and distribution of light, there still remains the necessity of an awakening on the part of the public to proper utilization of these developments.

Liquefying Coal

AT the Chemical Congress recently held in Stuttgart the well-known technical expert, Dr Friedrich Bergius, gave an interesting account of an important new process devised by him and his associates by means of which it is possible to transform gas oil crude oils containing large percentages of asphalt (e g., Mexican petroleum) etc almost completely into light oils without the formation of coke.

The development of this transformation of heavy oils into light oils such as benzine and gasoline has been considered one of the most important problems presented to petroleum technologists. At the present time in this country the light oils used for driving motors are prepared by the so-called cracking processes, which are based upon the fact that when the crude oils are heated at a high temperature under increased pressure the heavy oils break up into light oils, this action being accompanied by the formation of coke and gaseous hydrocarbons. One of the best known of the cracking processes is that formulated by Burton. This is suitable however only for medium heavy oils especially for gas oil since in the case of very heavy oils and of those rich in asphalt there are serious losses of gas and coke and also because the large amount of coke formed introduces technical difficulties. For these reasons the cracking process is not applicable to those oils which contain large amounts of asphalt, though these constitute a large part of the world's output.

The formation of coke during the cracking process is due to the separation out of hydrogen and of gases rich in hydrogen during the process of heating. Consequently many attempts have been made during the last few years to overcome this difficulty by the introduction of hydrogen and naturally catalytic methods suggested themselves as appropriate for this purpose. Since, however it was found impracticable to make use of catalysers for the hydration of impure crude oil, it was necessary to devise a special method of accomplishing this reaction.

In 1913 such a method was devised in the laboratory of Dr Bergius a method that is for preventing the impoverishment of the oils in hydrogen during the cracking process. This is accomplished by performing the cracking in the presence of hydrogen under a high degree of pressure. With a sufficiently high pressure and a suitable temperature, it was found easily possible to obtain the desired effect without the presence of catalysers.

Dr Bergius states positively that this reaction has been found applicable to the most various kinds of oils, oil residues and even to coal. It is this principle upon which is based the commercial technical process known as the Bergin process. This process can also be adapted to such products as brown coal or lignite generator tar. The loss of material through the formation of gas is trifling; moreover by suitable alterations in the duration of the reaction greater or smaller amounts as desired of benzine and petroleum may be obtained.

Because of this adaptability of the process, the crude oil can be broken up at will into light or medium products, according to the demand of the market at any given time.

Dr Bergius goes still farther. He states that by the use of this same method of operation the hydration and liquefaction of mineral coal is possible. Berthelot indeed, proved that coal is reducible, by treating the carbon with hydriodic acid.

Because of the experiments made by Dr Bergius and his colleagues with regard to the production of coal from cellulose and the resultant views formed by them as to the chemical nature of coal, they came to the conclusion that under the proper conditions a reaction could be obtained between coal and hydrogen. Such a reaction was discovered in the summer of 1913 and a patent was applied for on August 9th of that year—it is described as follows:

By heating coal in the presence of hydrogen under a pressure of 100 to 200 atmospheres, the coal can be almost entirely decomposed. If the proper conditions of operation be observed, about 85 per cent of a specimen of coal yielding 36 per cent of ash can be liquefied.

It was necessary of course, to spend years of work in order to obtain a practical method of making use of this brilliant achievement. The first commercial plant for this purpose has been erected in Mannheim-Rheinau during the last year or so.

Convincing proof has been given, says Dr. Bergius, that the very great [illegible] of [illegible] [illegible] [illegible] [illegible] of the [illegible] the laboratory are [illegible] [illegible] [illegible]

Miscellaneous Notes

Can This Killer Be "Converted"?—The German submarine "U-20," that sank the *Lusitania* and later was driven ashore off Jutland, may be converted into a seaside restaurant.

Cremation Not Fashionable in Paris.—The Paris crematorium may have to close down. Similar institutions in Hungary are thriving, but Parisians cling to the customs of the old church.

Toy Balloons for Golfers.—These are not for the benefit of those who find the regulation ball too small to hit; they are floated over the flags to guide golfers unfamiliar with the course.

The Alhambra Under Repair.—By government order the famous Alhambra, the most beautiful example of old Moorish architecture, is to be thoroughly restored.

A Permanent World's Fair.—Paris plans to house such a fair in a ten-story building with a 25-story tower. It is to be a permanent exhibition of the whole world's industries and their products.

Senator Penrose as Showman.—Senator Penrose is putting a stage and motion picture outfit in his Washington apartments. He will give two shows a week for invited guests; the first will be George Arliss in "Disraeli."

Business as Usual While Traveling.—The German railway administration purposes to install business offices on trains, including folding tables and typewriters, for the use of traveling men of affairs.

College Men's Earning Power.—What is the average income of the college graduate ten years after leaving college? As indicated by the income tax reports of the 1911 class of the University of Chicago it is $5,763; the lowest income was $800.

Tea Imports from Japan.—In 1918 Japan sent to America 50,000 tons of tea; in 1920, 30,000 tons; and in 1920 dropped to 28,000 tons. India and Java black teas seem largely to have supplanted Japan's on the American market and 1921 is expected to disclose a further decrease of from 30 to 40 per cent.

Leaky Torpedoes in Our Navy.—No, it is not a defect in construction. Each torpedo carries as fuel two gallons of first-grade alcohol, and it was found that members of the crew were relieving them of this "load." Officers have decided that better care must be kept of the key to the cellar.

Paris Still a "Fast" City.—With nothing worthy the name of systematic traffic regulation Paris allows her taxicabs and cars to race wildly about, utterly regardless of pedestrians. In 1920 the number of accidents was 60,375, an average of 165 a day. Paris evidently has no equivalent for the term, "Safety first."

A New Use for the Fireless Cooker.—The fireless cooker may often be used to advantage when setting bread sponge or dough to rise. Sponge requires an even temperature of 60 to 75 degrees F., and dough from 80 to 85 degrees. Use the cooker for this purpose in very hot or very cold weather, determining its temperature with a thermometer.

Our Foreign-Trade Perversity.—An American found in a Java store many American canned goods, and was told these were well liked but that it was improbable that they would continue to stock them after European trade routes became normal, since the canners refused to put the products in the smaller-size, liter cans that the Javanese demand.

Arkwright's Spinning Jack.—The Science Museum, South Kensington, has just acquired the only known specimen of the original Arkwright spinning jack, which has been in the Swain family for 150 years. It has 48 spindles, and is worked by hand with a 5-foot wooden flywheel. Arkwright, after attempting perpetual motion, completed in 1768 a machine for spinning cotton thread.

Men as Plow-Horses.—In war-ridden Mexico, and particularly in the State of Morelos, horses are scarce. The Government has recently dispossessed the twenty-two landlords who practically owned the whole State, and has apportioned the land in small tracts to laborers. It is a common sight to see men harnessed to plows, and their efforts to increase the productivity of this fertile region are said to be meeting with deserved success.

A Forward Step in Horology.—The new Horological Institute of America perfected its plans in a conference held in New York. With the co-operation of the National Research Council the Institute hopes to promote the science of time-keeping, develop a system of horological schools, install practical courses in manual training schools, provide satisfactory means for the certification of watchmakers, and unite into one national organization all persons interested in the art. Headquarters will be in Washington, and branches will be established in all important centers.

Oriental Trade School on Wall Street.—A new field for New York University is opened with the Division of Oriental Commerce and Politics, which will train its pupils in Eastern ways and seek to develop an invincible combination of the diplomat and the business man. This will put at the service of our smaller enterprises the facilities and methods of which our greatest commercial interests have long availed themselves. It is impossible to exaggerate the benefits accruing to us if we take put our commercial relationships with the teeming millions of Asia on a sound and friendly basis.

The Mechanism of the Psychic

(Continued from page 60)

number of pieces of apparatus already in general use—hypnotic wheels, revolving mirrors, biometers, sthenometers photographic and X-ray apparatus, scales and balances for weighing tests, a kymograph for taking graphic records, as well as various pieces of apparatus devised by French investigators (Boirac Joire, Fortin, Puyfontaine Thore, Count de Tromelin Baraduc and others) We have also duplicated the apparatus of Sir William Crookes and some of Dr Hare's. We have Dr Abrutz famous board which apparently registers the pressure of the human will We have several devices for testing unconscious muscular action on the part of the subject. We have much ordinary electrical and psychological apparatus, suitable for general laboratory work. We have a dictaphone to which we have attached an amplifying apparatus, so that sounds which occur during a séance or in a haunted house may be recorded and magnified We have galvanometers, by means of which we can test the psychic and record the psycho-galvanic reflexes as suggested by Mr W Whately Smith. We have various luminous screens which are said to glow with increased brilliancy in the presence of an added energy or an astral body We have a delicate electrical apparatus designed to test the vital radiation from the finger-tips. We have an electrically controlled apparatus which will at once indicate any added or subtracted electric energy either in the medium s body or in the body of any individual member of the circle. We also have constructed an electrical device which will emit an audible sound when any body approaches it, so that, if no physical body is in the immediate proximity of the apparatus and it emits its characteristic sound, we may presume that some invisible body is approaching it.

It is my hope that we may be enabled the coming winter to undertake some researches upon the human aura by means of some new apparatus which we have planned and also experiments in weighing and photographing the body at the moment of death and in recording radiations emitted by living and possibly by dead bodies If our endowment is sufficient I hope that we may also be enabled to construct and test out the elaborate apparatus devised by Drs Matla and Zaalberg van Zelst, of Holland and also to duplicate Dr Grunewald s ingenious apparatus.

It is my belief that much may be gained by attempts to duplicate by artificial means certain spiritistic and psychical phenomena and in this manner to ascertain the possible relations or connections between these phenomena, and other physical or electrical phenomena, better known All advance in science is made by dovetailing the unknown into the known and showing their possible connections It is the same here In attempting to duplicate certain psychic phenomena we may at least discover some useful analogies which may guide further investigation A number of experiments along this line are more or less definitely formulated and will presumably be made as opportunity arises Of these it is perhaps not in order to speak here One experiment I must mention in some detail, however because it has actually been performed. It should of course be repeated many times by many other investigators nevertheless the results obtained in our first performance are sufficiently curious and thought-provoking to deserve statement.

We all know of the old lifting game, in which four persons lift a fifth seated in a chair by placing their fingers under the arms and knees of the seated person All four persons doing the lifting bend forward several times, in unison inhaling and exhaling deeply together The person seated in the chair also inhales and exhales at the same time On the fifth count (say) all five persons hold their breath the fingers of the four lifters are rapidly inserted under the arms and legs of the seated subject, and the lift is made. It is a fact which practically everyone will attest, that, under these circumstances the person lifted seems to lose weight A heavy man whom it is found impossible to lift at first will be lifted with apparent ease upon the lifters four fingers, after the breathing and bending exercises have been taken That is the subjective impression of the lifters The question of course is Is there really any loss of weight, or is this simply a subjective impression?

Although this test has been tried by many thousands of persons it is curious that no one ever seems to have thought of putting the matter to the test by trying it upon registering scales upon which the combined weight would every moment be in evidence This test we undertook On the afternoon of July 25 1921 we tried this experiment a number of times upon the platform of one of the large self registering scales of 2000-pound capacity This scale had been especially adjusted with the greatest exactitude for our test, and its accuracy was checked off before and after the experiment.

Those doing the lifting were: Mr William Russell of our laboratory Mr Burling Hull, conjuror Mr Albert Poyner of the Toledo Scales Company; and myself The subject lifted was Miss Kay MacCausland The reader of the weights recorded during the various lifts was Mr W J Mahnken an engineer of the scales company

A chair was placed in the center of the weighing platform Upon this the subject to be lifted was seated. The four lifters took up their positions upon four corners of the platform Our combined weight was 712 pounds. Movements upon our part produced only slight oscillations of the recording needle. Deep breathing produced almost no appreciable effect.

Under these circumstances, the necessary bendings and breathings were undertaken. On the fifth count, the lift was made—[illegible] lasting about five seconds. On the first lift the [illegible] stated that the needle on the dial had fallen to 660 pounds—a loss of 52 pounds! On the second lift, there was an apparent loss of 60 pounds. On the third, fourth and fifth lifts, of 60 pounds. These losses tallied with the subjective feelings of the lifters, who also felt that weight had been lost. How account for these remarkable results?

If I lifted a chair while standing upon the platform, the dial first of all showed a sudden increase of weight, then a lessened weight, and finally swung back to normal. If I "squatted" on my toes, and suddenly rose to an upright position, a similar gain and then loss of weight was observed. In our lifting tests however, no gain of weight was at any time reported, invariably a loss, which however slowly returned to normal, as the subject was held for some considerable time in the air I have no theory to offer as to these observations, which I cannot fully explain I merely give the facts as recorded hoping that others may check off our results and discover what freak in the laws of mechanics was responsible for the results we obtained It is at all events most curious that these apparent losses of weight coincided with the subjective feelings of the lifters.

This brief summary will at all events, I hope, show the problem before us, as we have formulated it. We desire not only to study mediums (though we should of course be most glad to study them if available!) but also to duplicate and reproduce psychical phenomena by electrical and physical means and to conduct varied experiments upon subjects in hypnosis, sleep trance and other induced states. It is our hope that we may in this way be enabled to discover some facts of considerable interest and importance which will serve, not only to throw light upon psychical and spiritistic phenomena, but which will also tend to show the relations, should they exist, between these manifestations and others better understood. The ultimate for which we dare hope would be to succeed in proving the existence and showing the nature of a subtle energy active within the body and radiating from it—an energy upon which many phenomena depend and which may be in fact, the vehicle of mind itself It is hardly necessary to say that this discovery if ever made would constitute one of the most fundamental and important and far-reaching conclusions of modern science

This discussion comprises an abstract, made by the editors of parts of my address before the recent International Congress of Psychic Research in Copenhagen.

Salt Enough to Bury Land One and One-half Miles Deep

THE Biblical inquiry Ye are the salt of the earth but if the salt have lost his savour wherewith shall it be salted? figuratively speaking can be successfully answered by the sea if the waters will only yield their contents. The ocean contains enough seasoning material to form a block of salt measuring 4 800 000 cubic miles.

More graphically expressed perhaps, is the measurement which indicates that there is sufficient salt in the vast bodies of waters to form a crust more than one and one-half miles deep over the entire surface of the United States barring Alaska. Or expressing the volume of saline matter present in the sea in a third form, one per cent of the seasoning contents of the ocean would envelop the dry lands of the universe to a depth of 290 feet.

Some imaginary calculations, you exclaim! No these are the figures of the Geological Survey of the United States Department of the Interior and perchance any discrepancies are found kindly inform the statistician of this Government bureau. His business involves the keeping tab, numerically speaking on things pertaining to the earth—whether it be salt or gold He lives, moves, and virtually has his being in cold-blooded figures.

By the same token the Geological Survey reasons that each person in the United States was allotted 130 pounds of salt during the past year—assuming the improbable condition of each individual partaking of an equal amount of seasoning in his or her food. The production of salt in 1920 was 6 965 138 short tons valued at $30 389 102. Not all salt is for table use, however for there are a variety of ways of consuming the product Preserving meat, curing fish, hides, dairying refrigerating making glaze on pottery enameling making pickles and salting live stock.—By S R. Winters.

Power Gas from Sewage

RECENT experiments at Birmingham have shown that it is practical and economical to drive a suction-gas engine from gas derived from sewage sludge. The pump installation comprises a 84-horsepower horizontal gas engine of the ordinary suction type, a 6-inch-diameter centrifugal sludge-pump and other parts. The engine is capable of giving 84 brake-horsepower at 260 revolutions per minute with town gas having a heat value of 500 to 550 British thermal units per cubic foot. In tests made with sewage gas, from 37½ to 52 horsepower maximum have been obtained.

The principal constituents of sewage gas are methane hydrogen and nitrogen and carbon dioxide, the per cent of marsh gas varying in various places investigated in accordance with local conditions. The volume of wet sludge dealt with at Birmingham is estimated at not less than [illegible] tons per year J D Watson (Engineering [illegible] 23, 1921) estimates that from this sludge [illegible] tons of dry solid matter are available to produce [illegible] cubic feet of gas equal to [illegible] horsepower-hours, equivalent to [illegible] horsepower per day of 10 hours.

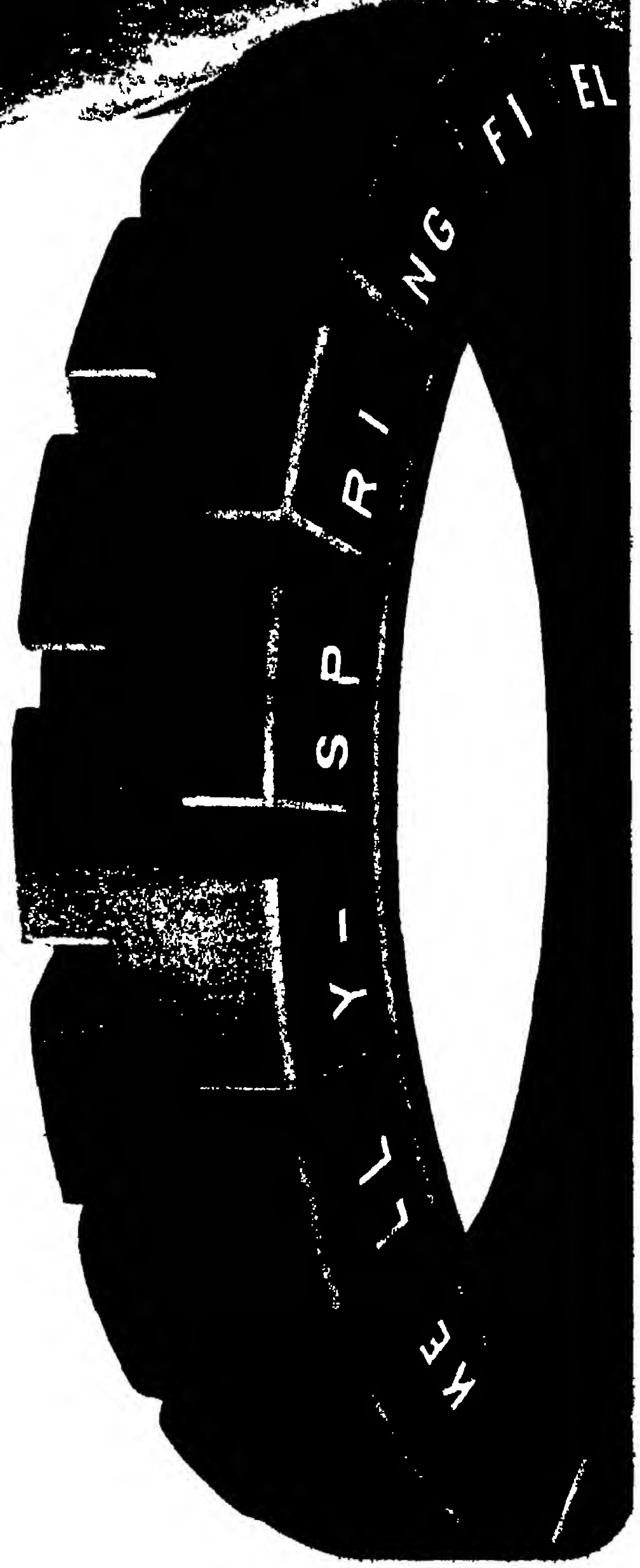
SCIENTIFIC AMERICAN

The Monthly Journal of Practical Information

a Copy FEBRUARY 1922 $4.00 a Year

AN INCIDENT OF PREHISTORIC LIFE THE RHODESIAN CAVE MAN STARTLED BY AN INTRUDER [See page 90]

Co., Munn & Co., New York, N.Y.



When you want traction, use Caterpillars

The total weight of the pulled load in the picture above is 26 tons. The same truck—a 4-ton Fageol owned by the G. W. Thomas Drayage and Rigging Company of San Francisco—has pulled a load of 60 tons.

This performance speaks for itself as to the traction afforded by a set of Caterpillar tires. No matter how powerful a truck may be, the tires have got to do their part or the load won't move.

If you want dependable traction as well as dependable mileage, equip your truck with Kelly Caterpillars.

Made in sizes suitable for trucks of every type and weight

KELLY-SPRINGFIELD TIRE CO.

GENERAL SALES DEPARTMENT 1710 BROADWAY, NEW YORK

Promises—Made, Fulfilled, and to Come

You have now come with us to the fourth issue of the *Scientific American* in the new monthly form, and you have been through the strenuous publishing days when two distinct periodicals—*Scientific American* and *Scientific American Monthly*—had to be discontinued at one and the same time with the preparation of this new and greater magazine. In the days of transition we gave promise of many new improvements, that the bettering of your *Scientific American* had only been begun.

One of the promises made at the inception of this new journal was the almost *total freedom* from "Continued on Page —" and so we have eliminated almost entirely the turning from page to page to complete an article. Besides the irksomeness of constant "turn-overs" this new feature makes *Scientific American* more valuable to the vast host of readers who use the articles in its columns for clipping and reference work.

As the November, December and January issues have come and gone, improvements have followed on improvements, the new stride of the monthly allowing far greater editorial opportunities. In step with these opportunities, the *Scientific American* has incorporated important writers on its already very comprehensive list *of* corresponding editors. Men of recognized authority in their fields, their articles lend greater scope to the reading—among the new Corresponding Editors are such men as Edward G Spaulding, Ph D , LL.D., Princeton University; Samuel J. Record, Professor of Forest Products, Yale University; Saul Dushman, Ph.D., G. E. Research Laboratory; Leon A. Hausman, Ph.D , Cornell; M. Luckiesh, Director of Applied Science, Nela Research Laboratories; W. A. Murrill, Ph.D , New York Botanical Garden.

Science has taken us today to the farthermost corners of the globe The *Scientific American* editors have long since stopped to think in terms of New York, Chicago, San Francisco and other American cities. Today they are thinking in terms of Peking, Petrograd, Paris, Cape Town, Calcutta, Vienna, Sydney, Buenos Aires, and so on. To that end we have secured correspondents in various parts of the world, supplementing the hundreds of foreign periodicals which come to us monthly for abstracting

There is no greater hobby these days than *Radio*. Over 300,000 radio amateurs in this country give ample proof of this, and it is our purpose therefore to keep close watch on all radio developments, and to report current achievements of broad interest to this great group of radio enthusiasts. It is in keeping with the scientific spirit of this great journal to foster the developments in the many fields of science—a policy that has been followed for 77 long years.

For future days there is a great mission for the *Scientific American*, and that is to blaze the trail in *new* sciences. Fearlessly, yet cautiously, it has investigated unknown realms of science heretofore left to others to explore and develop The psychic science is one of these, and during the months to come we intend to present the leading opinions of the world on this fascinating side of science.

For the expert and the man who puts the columns of *Scientific American* into daily application, the various departments will offer boundless information in tabloid form. Large numbers of domestic and foreign periodicals, government reports, papers of scientific societies, engineering reports; all submit to the boiling down process for the reader's assistance

The year 1922 is certain to be rich in technical achievements. Recovering from the major effects of the World War, all nations are now getting down to hard work. This laying aside of the frock coat and donning the overalls must have a far-reaching effect Scientific research turns from destroying life to making this world a better, more efficient and happier place to live in. And in proportion, the work of *Scientific American* has become all the greater—all the more important

Today, and throughout 1922, you cannot afford to be without the *Scientific American* for guidance, information and keeping abreast of the best achievements of man

TO BE A READER OF SCIENTIFIC AMERICAN IS TO BE THOROUGHLY AND ACCURATELY INFORMED

The Scientific American, February, 1922. Volume 126, Number 2. Published monthly by Scientific American Publishing Company at 233 Broadway, New York N Y Subscription price $4.00 per year. Entered as second-class matter June 18, 1879, at the post office at New York, N Y, under the act of March 3, 1879

67% reduction on Wells Outline of History. An offer we can never make again. Pay only a few cents a month. But reserve your copy by clipping the coupon now—today!

Was this the flood of the Biblical story?

The most terrific catastrophe of ancient times occurred twelve thousand years ago. There was no Mediterranean Sea then—only a rich and fertile valley filled with men and women whose life seemed easy and secure.

One day without warning, the water came. The Atlantic Ocean burst its walls and swept into the valley engulfing the tribes. Torrents of rain from the melting ice of the North swelled the inundation. Terror stricken men and women fled to higher ground but the water followed faster and where the peaceful valley had been there was a blank, silent sea and nothing more.

Did any fugitives escape this wholesale destruction? Were their memories of those awful days interwoven with the legends of the tribes to which they fled? Was it from this that humanity gained its story of the flood which is a part of the sacred literature of so many lands?

The interesting thing about H. G. Wells' Outline of History is that it makes *every thing* you have ever read before more interesting and valuable to you. Into that master story he has woven *all* the fragments of knowledge which we busy modern folks have picked up here and there in our education and reading. All that we read in school, all that we read in fugitive books, all the events in the day's news—these find their place and relationship in the great story of humanity's progress told by the greatest modern story teller.

H. G. WELLS' "Outline of History"

Now Offered You at One-Third the Original Price

Perhaps you think the Roman Empire existed long ago—perhaps you think of the old Greek and Roman civilization as "Ancient History."

Not a bit of it. Compared with the many centuries of life that Wells tells about, these empires flourished only yesterday. Wells begins at the real beginning and down through the centuries he carries you, upsetting fairy stories that you have heard all your life—amazing you often, startling you in almost every chapter, but entertaining you on every page as you have never imagined that you could be entertained by history. This is Wells, and we offer him to you now at

A Bargain You Will Never Get Again

"The man who finishes this volume will be an educated man, however much, however little he knew when he started."
—Baltimore Evening Sun

There you have it in a sentence—the reason why 250,000 men and women have paid $10.50 for Wells' Outline and felt they were getting it cheap. The Outline is more than a history—it is an education—the orderly knowledge of human progress which men go to college *four years* to get—and often come away without.

Voluntarily Wells has slashed his royalties 85% and entered into a contract with the Review of Reviews by which a new edition of the Outline can be offered to Americans—to you—at one-third the former price.

Think of it—the original plates and illustrations, but revised by Wells himself and printed in one handy thin paper volume instead of two. Nothing omitted, better than the original because it has been improved by Wells himself.

*There Is Just One Condition

Only one condition we make—that you send in your coupon at once. The presses are running, the books are streaming in from the bindery. But we can make only one edition. We must know now how many to print. We cannot supply those who come too late.

As the New Republic truly says, The Outline is too big even for publishers' superlatives. Without superlatives therefore let us say very earnestly: *If you want the opportunity of examining Wells' Outline free in your own home for a week, do not lay this page down until you have made your reservation by clipping the coupon.*

And The Review of Reviews Too

For Thirty Years the Standard of Usefulness and Authority

Where Wells' story leaves off the Review of Reviews takes up the record of human achievement. His is the history of the past; the Review of Reviews records and interprets for you the story of today. It is fitting that the two should be joined together; and only by joining them can we make the remarkable offer detailed on the coupon below.

Review of Reviews Co.
30 Irving Place
New York City

Send me on approval, charges paid by you, Wells' Outline of History in the latest revised edition at the special one-third price. Also enter my subscription to the Review of Reviews for 2 full years, at the regular 2 yr price—$8.50. I will either send you 50c in 5 days and $1 a month thereafter for 9 months, or I will return the Wells History within a week, send you 25c for the first copy of the magazine delivered, and cancel this order. (For the luxurious full leather binding add 2 more payments.)

NAME
ADDRESS
OCCUPATION

For full cash with order send only $8.00

HOW MANY PEOPLE HAS HENRY FORD FOOLED?

Are they legion—or has their faith in him as a great American Genius been justified?

THE FORUM

Edited by George Henry Payne

America's Most Brilliant Magazine

In its February, 1922, issue contains startling revelations concerning the Middle Western automobile manufacturer and his recent purchase of a railroad.

The February issue, among its well balanced array of articles by world authorities on art, economics, science, literature and politics, will also contain

"Can An Animal's Intelligence Equal Man's?" by M. de Molostwoff, distinguished Russian naturalist and Member of the Petrograd Academy of Science.

Recent contributors to THE FORUM include: Viscount Haldane, Prince Bibesco, Dr. George M. Vincent, Havelock Ellis, Georg Brandes, Lady Astor, Otto H. Kahn, Count Tolstoy, Maurice Hewlett, George W. Wickersham, and others of equal importance.

Our trial subscription offer will bring you four issues of THE FORUM for $1.00. But when you have come to know THE FORUM, four months will not satisfy you—you will want it through the years. It is the greatest intellectual magazine of the day.

Regular Yearly Subscription Rate, $4.00

Published Monthly by

The Forum Publishing Company

354 Fourth Ave., New York

With the Editors

IMAGINE hundreds of thousands of pairs of critical eyes, backed up by trained and analytical minds, going over your work month by month. Yet that is precisely our experience. Frankly we do not know of a more critical audience than our readers, and we are glad, even proud to be the purveyors of practical information to that very audience, even though it does mean an occasional word of criticism when an editorial gear gets out of mesh Thus we recently made a rather unfortunate choice of words in describing a high-voltage electrical experiment No sooner was that issue in the hands of our readers than we received letter after letter, pointing out the awkwardness of our statement Our meaning was clear to be sure but our readers suggested how another and totally inaccurate meaning could be read into our statement. Then we had the sinking of a battleship and we confounded the bow with the stern Again the critics got busy And so it goes. Still that is precisely as it should be, for if the SCIENTIFIC AMERICAN is not keyed up to the highest possible standard of accuracy at all times it must needs lose much of its value.

BY the way we said at the beginning of the foregoing note that several hundred thousand pairs of critical eyes went over our work month by month This brings another thought to mind and calls for an explanation While our circulation is actually in the neighborhood of 100 000 copies per month each copy is read by a number of persons just how many we do not know So the total number of readers is far in excess of 100 000 it must be at least half a million Librarians will tell you that there is more call for the SCIENTIFIC AMERICAN than for any other periodical. We know of a wealthy farmer down South, who subscribes for this journal After he gets through reading it he mails it to a relative up North who reads it in turn and passes it on to his father The father, when he is through with it passes it on to another friend and from that friend the dog-eared paper considerably the worse from such wear finds its way to a hospital, there to be read by many more persons Little wonder that the humorous member of our staff after hearing about this case, suggested that we print the magazine with perishable ink, which would be visible only long enough for one reader to get through it!

THE topic of the hour is radio Overnight, a nation wide interest in radio has come into being because of the establishing of several radio telephone broadcasting stations in various parts of the country Only a few weeks ago one of our members was invited to deliver a talk on amateur radio at the broadcasting station in Newark N J This he did, and he was heard by an unnumbered audience over thousands of square miles. One amateur located in Clinton Iowa, wrote in saying how he had enjoyed every word of that speech — over a distance of 1000 miles mind you! The writer of these lines also wanted to hear his brother editor's speech so he took home with him that evening a miscellaneous collection of batteries, telephones, wire, receiving set, vacuum tubes, insulators, and so on It was the work of but a half hour to connect the equipment and throw a 60-foot wire out of the second-story window. The dry cells, due to the three-ampere drain made by the vacuum tubes, did not stand up, and the beginning of said brother editor's talk was completely lost But then the writer remembered the neighbor's Ford and the storage battery contained therein. Once the storage battery was installed excellent results are obtained. The tail end of the talk was readily picked up—clear and loud over a distance of some fifty miles with high hills intervening then came the news of the day musical selections stock reports official time signals etc So enthused have we become over this radio idea that we are preparing a long and explicit article for the March issue, telling all about these broadcasting stations where they are located what kind of equipment is necessary at various distances away to intercept the messages and music and how to install said equipment Furthermore we are prepared to answer all inquiries on this subject

WE have been criticized for the absence of the human element from our pages With the reservation that the human element is hidden in every piece of machinery if we but search for it with the thought in mind of what the use of the new apparatus means to men we can plead guilty to this indictment It is a fact that our field involves things rather than people and that it is seldom that actual personalities are in their place in our columns Occasionally there is an exception however Such was the Edison story in our first monthly issue which was distinctly scientific while permeated throughout with Mr Edison's personality Such again is the story which Mr Collins tells us of Mr Wood in the present issue —a tale of a wonderful new machine which would have failed temporarily at least if it had been introduced strictly on its merits and without the personality of the man behind it to push it through

THE fuel problem is always with us. Sometimes its discussion takes the form of a proposal to save fuel by substituting the water power sources which are used without being used up Sometimes it has to do with the measures which are quietly taking shape behind the scenes to enable us to go on driving our automobiles after we have exhausted the underground stores of liquid petroleum Sometimes it turns about the issue of fuel for steam This month the fuel problem is with us in considerable detail Mr Skerrett catalogs our resources in fuels of all descriptions Mr Dacy tells us what we may reasonably expect from the lower members of the coal family which have not heretofore been called upon to support their fair share of our industrial establishment And Mr Dachnowski puts before us the need of examining with the utmost care and the utmost system every possibility however crude the raw material with which it may be concerned

THE editors have rather got in the way of looking forward to the receipt of a bulky package bearing the Ithaca post mark and containing a manuscript and a collection of pictures setting forth Dr Hausman's latest doings His work possesses a rare combination of immediate practical value interest alike to the eye and the mind and susceptibility of being described in rich detail without embarrassment to the reader of average attainments. We hope that the people who buy the SCIENTIFIC AMERICAN are as well pleased with what Dr Hausman tells them in this and other issues and with the way in which he tells it as are those of us who make the paper

CONTENTS

FEBRUARY, 1922

LEADING ARTICLES

SHORT ARTICLES

DEPARTMENTS

SCIENTIFIC AMERICAN PUBLISHING COMPANY

Munn & Company, 233 Broadway, New York

Founded 1845

CHARLES ALLEN MUNN President ORSON D MUNN Treasurer
ALLAN C HOFFMAN Secretary

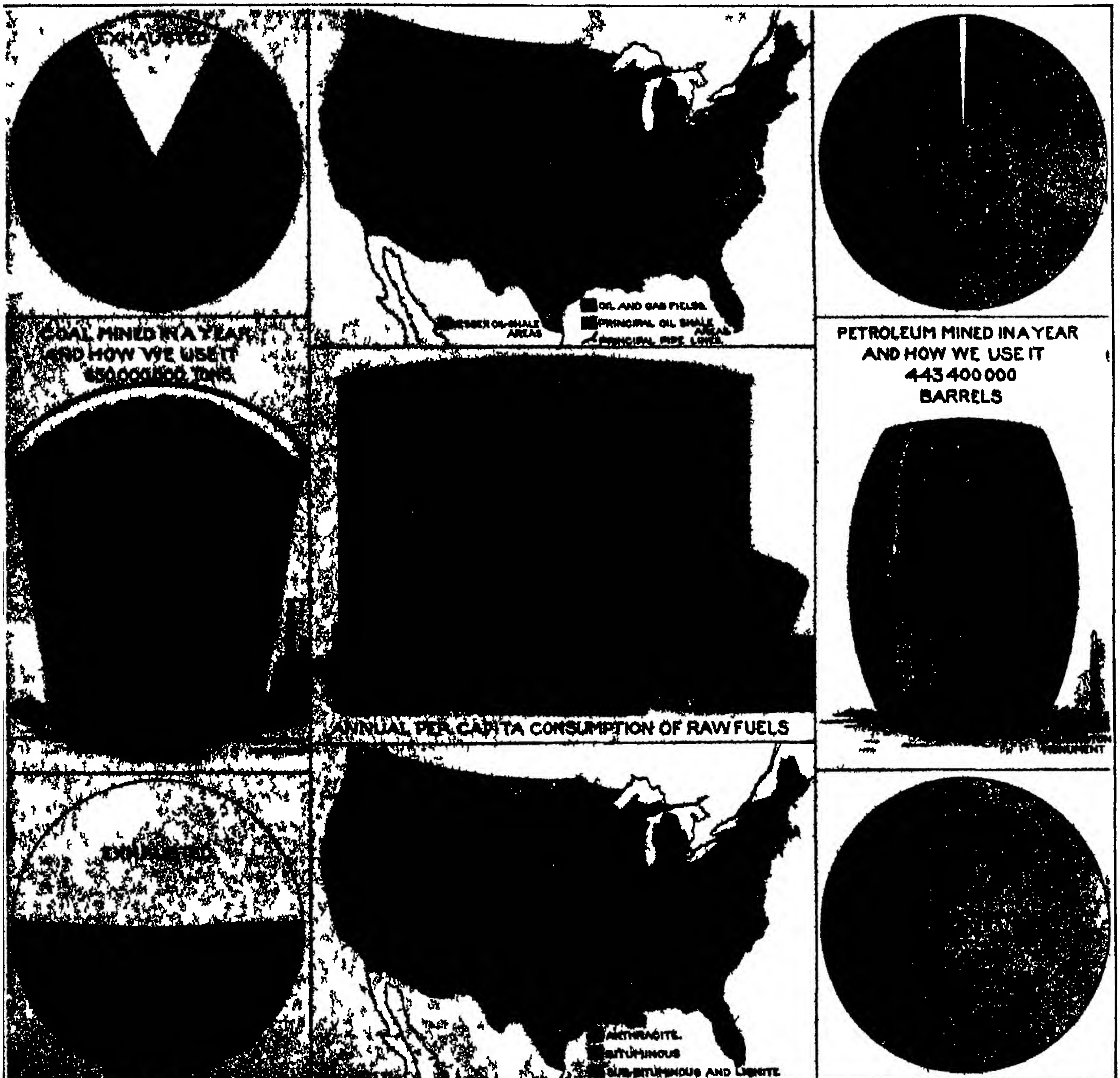
Vol 126 No 2 Published monthly Entered as second class matter June 18 1879 at the post office at New York, N Y under the Act of March 3 1879
Price, 35 cents a copy $4.00 a year Postage prepaid in United States and possessions and Mexico, Cuba and Panama $4.50 a year for Canada. Foreign subscriptions $5 00 a year postage prepaid

SEVENTY-EIGHTH YEAR

SCIENTIFIC AMERICAN

THE MONTHLY JOURNAL OF PRACTICAL INFORMATION

NEW YORK, FEBRUARY 1922



AMERICA'S FUEL RESOURCES AT A GLANCE.—(See pages 86 and 87)

America's Fuel Resources

What We Have and How We Are Using Them

By Robert G. Skerrett

FLAME meant in fact far less to those primitive peoples who bowed in superstitious reverence to fire than it does now to a civilized world which takes it largely as a matter of course.

The whole of our modern standard of life, the foundation of our many sided manufacturing activity, the carriage of a vast tonnage of commodities, and most of the comforts and conveniences which we deem indispensable are in the main the reflexes of present day adaptations of flame. In short we have turned fire to our purposes by making it the dominating source of energy—mechanical energy—we have transformed the sacrificial glimmer of the past into the dazzling glare of the industrial furnace. How many of us stop to think whence come the fuels essential to these varied services? Most of us give the subject little if any heed and deem our supplies inexhaustible.

When we first established ourselves permanently upon this continent dense forests covered the land well nigh from the very shores of the Atlantic to way beyond the western limits of the Mississippi Valley. The stands of timber for generations thereafter provided lumber for most of the homes reared for the gathering population and furnished the while fuel for the fireside, the shop, the mill and the factory. All of us know how we have ravaged our primeval forests, how we have reduced the measure of native lumber and the size of the domestic woodpile.

When the white man came to America to stay 300 years ago, nature had stored underground for his future use coals of all sorts to the measure of 3 541 000 000 000 tons and undreamed-of subterranean oil pools held an aggregate of 11 200 000 000 barrels of petroleum. Associated with the latter were incalculable trillions of cubic feet of natural gas. No one then realized the drains that would subsequently be made upon these age-old accumulations of potential heat and motive force. The story of what has since taken place points a lesson which every one of us should ponder and learn by heart, for how we profit by it, how we mend our ways intimately concern our whole social and industrial structure and our economic future.

According to the census of 1820 the population of the United States numbered 9 638 453. Up to that time we had mined and consumed the modest amount of 15 000 tons of coal, four fifths of which was anthracite from the Pennsylvania fields. This fact, certified to by the U. S. Geological Survey, makes it plain that the nation at large relied almost wholly upon its timber lands for fuel. Even as recently as 1860 the consumption of coal per capita did not exceed half a ton annually, and in 1880 our coal production reached only 71 481 570 tons—the equivalent of an allowance of 1.42 tons per person that year. The latest figures, however, show that we are taking out of our mines each twelvemonth an average of 650,000,000 tons of coal, both bituminous and anthracite, which is tantamount to six tons per capita. That is to say, out of a combined original deposit of anthracite, bituminous, and lignite coals we have used up since 1807 a matter of substantially 14 000 000 000 tons. This leaves us the tremendous total of 3 527 000 000 000 tons to draw upon. To be more specific, this reserve is made up of 17,000,000,000 tons of anthracite, 1 510,000 000 000 tons of bituminous coal, and 2 000 000 000,000 tons of lignite.

Our lignites are substantially untouched; from our bituminous store we have withdrawn less than 1 per cent of the original deposit, but the veins of anthracite have been so worked that at the present trend of consumption it is prophesied we shall exhaust them within the next 75 years. On the face of it, it seems that we have no cause for worry, but analysis reveals that there is ample warrant for concern. What are we going to use in place of anthracite when that smokeless fuel is no longer to be had, at least at a price that would make its burning economically feasible? All of our anthracite comes from a region in Pennsylvania covering an area of something under 500 square miles, while our bituminous coals are mined in no fewer than 30 States.

Apart from its smokelessness, anthracite has generally a high heating value and is therefore peculiarly suited for domestic purposes. Because of this the anthracite of Pennsylvania is distributed broadcast to consumers located within a region reaching east to Maine, west to Minnesota and south to Georgia. Not only that but the ordinances of many municipalities strictly prohibit the burning of bituminous coal within the city limits. This is done in the name of public health, protection of property, the avoidance of atmospheric pollution and the scattering of grime hither and thither. Our citizenry can not, for the reasons cited, view with indifference the approach of a day when bituminous coal, with its clouds of dense, black smoke, might have to be substituted for cleanly anthracite.

Exclusive of our steam railways we had in service in 1870 engines in our factories, mines, and quarries aggregating 2 460,832 horsepower. Today these same industries have steam plants totaling 31,250 000 horsepower. Our steam railroads now have at their disposal 50 000 000 horsepower, and if we add our steam and naval vessels, central stations, electric railways, and other enterprises using fuel for motive force, we have working for us 96 000 000 steam-generated horsepower. This employment of mechanical energy indicates how we have developed within the span of half a century; and explains in part why we are making steadily increasing inroads upon our coal fields. Besides having greatly advanced industrially in the last five decades our standards of living have mounted upon a corresponding scale.

The quantities of coal mined annually, however, are not a true index of our amplified use of motive energy, because liquid fuel has been utilized more and more for the raising of steam and for direct propulsion through the medium of the internal combustion engine. This state of affairs is familiar to all of us and is especially emphasized by the continually growing number of automotive vehicles seen on our streets and roads and by the ever widening adoption of the gasoline-driven tractor on the farm.

No one realized, in 1859, when petroleum was first struck in Pennsylvania, that the discovery of that oil was to effect profoundly our national life in many directions. In that year we drew from the ground 2000 barrels of the fluid, and there was a period, for some time afterward, when the output ranged between 2 000,000 and 3,000,000 barrels annually. It could be bought during that interval of moderate demand for a few cents a barrel, in short, the stuff was well-nigh a drug on the market.

Up to 1902 our employment of petroleum developed gradually and until then our oil fields in the eastern areas of the country satisfied our needs. From that time on we have exploited extensively and successfully the Mid Continent and the western sections of our oil-bearing lands, and today the Eastern Appalachian pools have become of minor importance. Indeed, in 1920 the latter region yielded but 30,500,000 barrels, while the Mid-Continent wells produced 240,000,000 barrels, and from California alone we obtained in the course of that twelvemonth nearly 105,000,000 barrels. From all our fields, two years back, we drew about 444,000,000 barrels. Since 1859 we have removed from our oil sands 5,467,000,000 barrels—i.e., 48½ per cent of the estimated workable subterranean store created in far-off geological ages.

In the main, until the advent of the automobile, kerosene was the primary aim in the refining of [illegible] and wrought wonders in furnishing a cheap and brilliant illuminant—supplanting the older "coal oil" which had been distilled previously from certain bituminous deposits. With the advent of the [illegible] conveyance gasoline, [illegible] in the manufacture of kerosene, [illegible] and now [illegible] the supporting backbone of the [illegible]. From petroleum, when [illegible] main products, i.e., gasoline, [illegible]

The coal storage shown in part in this view is located on the west bank of the Hudson River facing New York City. It contains over 240 000 tons of coal and is the fuel reserve of a New York electric light and power company. The big public utilities have to store large quantities of coal to tide them over in case of emergency

What coaling of a big city really means: one of New York's coal storages

[illegible], and a number of secondary products such as [illegible], vaseline, paraffin, [illegible] oil, asphalt, and petroleum coke. By recourse to "cracking processes" it is practicable to secure still higher percentages of the much-desired gasoline. The importance of this is brought home to us when we recall that we have quite 8,000,000 power-driven vehicles in service; and it is authoritatively declared that there will be double this number in use nine years hence. We are told that motor fuels represent a big percentage of petroleum consumption, and that they come next in volume to fuel oil.

Viewing frankly the situation that confronts us, and remembering the divers commodities that can be extracted from crude oil by the refinery, it is disturbing to learn that something like half of the petroleum produced in this country is burned under boilers for steam raising, thus sacrificing the more valuable main and secondary products. As has been well said, "The application of fuel oil to steam raising is an economic perversion." During 1921 our electric utilities alone consumed 12,608,728 barrels of fuel oil, the larger measure of which was used in the States of Texas and California. Fortunately, further increase of oil burning locomotives is reported checked, and, in the long run, coal must be relied upon to meet the fuel requirements of stationary steam plants. This is inevitable so that the ships of our merchant marine and the navy may be supplied with fuel oil.

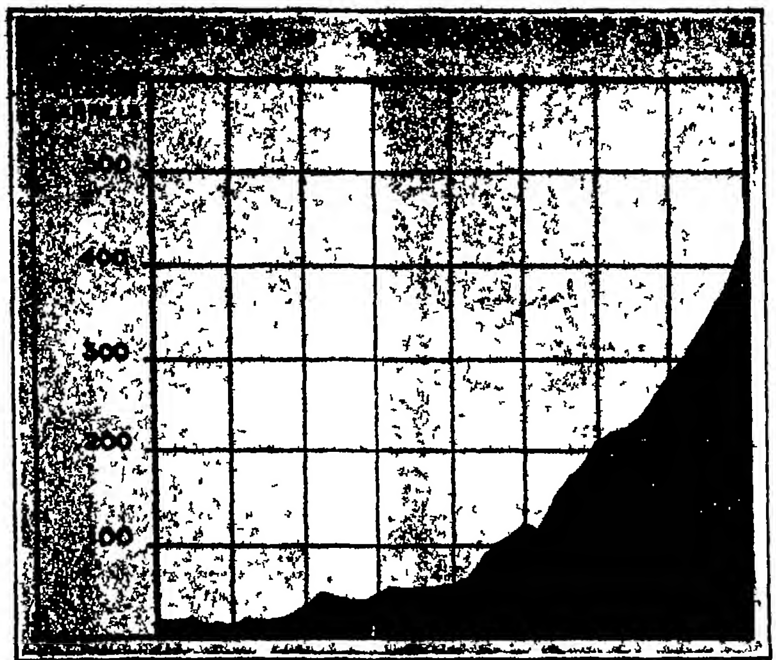
By reason of the special duties imposed upon the defensive fleet, and, on the other hand, the need of operating our ships of trade at the lowest practicable cost so that they can compete with the merchant craft of other nations, it is essential that the navy and the merchant marine be given preference in the utilization of crude or fuel oil. To this end, wherever feasible, both fighting and mercantile vessels should be equipped with engines of the so-called Diesel type. Much has been achieved in developing this order of internal combustion motor since its conception in 1898, and today the latest type of double-acting Diesel engine attains an efficiency four times that of the coal-fired steam engine and two and one-half times that of the triple-expansion oil fired steam engine.

Less than five years ago the U. S. Bureau of Mines stated: "*We are today using efficiently—i.e., for gasoline and lubricating purposes—not more than 30 per cent of our oils. The other 70 per cent is used in competition with coal or exported to foreign countries and is generally sold for less than the cost of production.*" While the situation has improved, our petroleum resources still stand to be exhausted within 50 years.

The average automobile requires in the course of a year more than ten barrels of gasoline. The net result of mechanical progress having done little toward reducing this unit consumption of gasoline, the present solution of the problem lies in meeting the growing demand by finding ways to manufacture still larger quantities of gasoline without correspondingly increasing the expenditure of crude petroleum.

Much has been done in this direction by greater recourse to cracking processes; and splendid results have been realized by the wider extraction of casing-head gasoline and recoveries of the liquid fuel from natural gas generally. During 1920 so-called "natural gasoline" was extracted from casing-head gas to the measure of 12,800,000 barrels. The cracking processes have not been developed to the possible maximum, and there are reasons to believe that through these agencies the yield from a given volume of petroleum might be considerably augmented. Undoubtedly more gasoline can be got from casing-head gas, but the percentage of gain is a matter of speculation, inasmuch as no one can foretell what gasoline content will be found hereafter in the gas rising from our oil wells.

Worthy of at least passing mention are the efforts to recover gasoline from [illegible] to improve by [illegible] the gasoline [illegible] and to [illegible] during [illegible]. In [illegible] this is



How our consumption of petroleum has climbed in the course of forty years

the cause of an annual gasoline wastage of 122,000,000 gallons—this dissipation being equivalent to about 8 per cent of the gasoline produced in the United States in a year from all fields and all sources. This evaporation loss should be cut down notably by the use of efficient equipment

Well over half a billion gallons of high-grade fuel oil are consumed annually in the manufacture of illuminating or artificial gas. The purpose of the oil is mainly to add hydrocarbons so as to increase the candlepower of the gas. The use of incandescent mantles and the adoption of a heat standard rather than one of luminosity would obviate the employment of this oil and yet make it possible to meet all of the requirements for lighting and cooking in the home. Incidentally, gas so prepared could be sold to the consumer at a correspondingly lower price

Of natural gas we burn usefully in a twelvemonth fully 800,000,000,000 cubic feet—equivalent to the heating value of 40,000,000 tons of coal, and something like 8,000,000 families are directly benefited by it in cooking, heating, and lighting. But the most significant aspect of this matter is that approximately two-thirds of the gas is used industrially The history of our treatment of natural gas is a record of wanton waste *Just think of it, in the course of one month gas was allowed to escape unchecked from a well yielding the while 1,000,000,000 cubic feet of the commodity and in two months four wells scattered broadcast a total of more than 5,000,000,000 cubic feet of gas!* This dissipation of potential heat corresponded to 250,000 tons of coal, or enough to supply *50,000 households for a year* By recourse to moderate expense for proper casing at our *gasoline wells an enormous conservation of this fuel might be effected.*

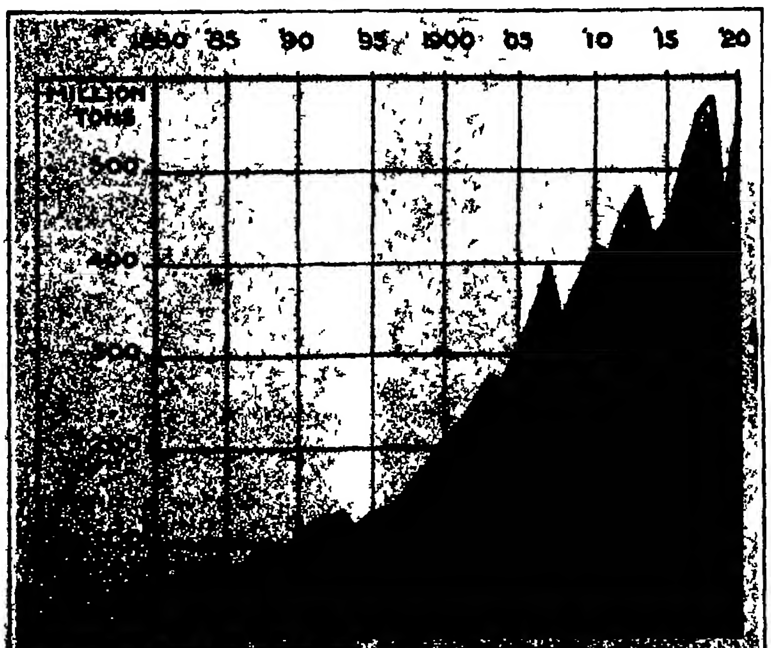
Before leaving the subject of our petroleum resources, let it be said that their potential exhaustion would not deprive us of a native reserve of liquid fuel We have in our widely distributed oil shales a store many times more extensive than our original deposits of petroleum The shales of Colorado alone are said to hold quite 20,000,000,000 barrels of oil, while those located in southwestern Indiana may possibly be made to produce 100,000,000,000 barrels. According to best authorities, a ton of Colorado–Utah shale would, by suitable extractive methods, give 50 gallons of oil from 17 to 25 pounds of ammonium sulfate, so useful as a fertilizer and 8000 cubic feet of gas. In Scotland the refining of oil shales has been pursued on a commercial scale for decades and our problem is to profit by that experience and to develop processes suited to our own needs. The cost of shale oil will be higher than that of petroleum oil but *its recovery will inevitably become one of our great industries.*

The time will surely come when we shall avail ourselves of our 2,000,000,000,000 tons of lignites and already much has been done here through promising researches carried out by the U S Bureau of Mines. It has been shown conclusively that this fuel can be used to the best advantage by adopting a carbonizing process. The carbonized lignite can then be manufactured into briquets, while the by-products of carbonization represent values in the form of gas, ammonia, oils, and tar The tars and oils can, in turn, be made to yield numerous worth while chemicals.

In conclusion, let us touch briefly upon what we can do when our anthracite is gone Our technicists have demonstrated, on a commercial scale, that we can have a plenty of smokeless fuel if we put our bituminous coal through the by-product coke oven. By this medium we may obtain the base of a so-called "artificial anthracite", in other words, secure from each ton of soft coal 1500 pounds of smokeless fuel, 10 000 cubic feet of gas, 22 pounds of ammonium sulfate 2½ gallons of benzol, and 9 gallons of tar This is what is termed the high-temperature process and the resultant coke usually contains only about 2 per cent of volatile matter which renders it difficult to ignite or to control in the ordinary stove or furnace

A more recent development is the low-temperature carbonization of coal This treatment leaves in the coke from 8 to 15 per cent of volatile matter, the fuel *ignites readily, burns without smoke, and is admirably* suited for domestic use As a by product there is an *oily tar double in quantity to that got by high-temperature* carbonization This tar can be made *to yield goodly quantities of motor fuel,* both burning and lubricating oils, and moderate amounts of *pitch—not to mention liberal percentages* of cresols and phenols. While there is less gas given off, it is of a higher caloric value than the gas realized by the high-temperature method A ton of coal carbonized by the low-temperature process furnishes from thirteen hundred to fifteen hundred pounds of coke from two thousand to seven thousand cubic feet of gas, from twenty to thirty gallons of tar, and from two to eight pounds of ammonium sulfate.

Alcohol is sure to play a conspicuous part in the motor fuels of the future, and the sources from which this can be obtained are numerous and extensive. Again benzol can and is being garnered from gas houses and coke ovens and combinations of alcohol and benzol have shown excellent qualities as motor fuels. While research has revealed that we may look forward undismayed and be sure of an abundance of fuels for all purposes, still we must not lose sight of the fact that most of the substitutes for those in common use will entail heavier costs and mechanical modifications before their general adoption Such being the outlook, it behooves us to employ our present fuels more carefully



The record of our coal consumption since 1880

Bridging the Detroit River

Suspension Bridge of 1803-Foot Span Will Connect Detroit With Canada

THE early years of the twentieth century will be spoken of in future histories of bridge construction as the era of the long span bridge. It is true that the last two decades of the nineteenth century saw the construction of the Brooklyn suspension bridge and the Forth cantilever bridge. But the first two decades of the present century have witnessed the building of the longest truss bridge at Sciotoville, over the Ohio River, the longest cantilever bridge over the Saint Lawrence near Quebec, the longest arch bridge at Hellgate over the East River, and of two additional suspension bridges of the first magnitude in the Manhattan and Williamsburg bridges across the East River. Furthermore before the present century is 30 years old the colossal Hudson River bridge will have been opened for service.

Two other long span bridges have recently been authorized and doubtless in due course will be completed. One of these with a span of 1750 feet will span the Delaware between Camden and Philadelphia. A description of this large structure will be found in the issue of the SCIENTIFIC AMERICAN of July 2, 1921. And now the city of Detroit has determined to provide a great highway for railroad and vehicle traffic across the Detroit River, thereby linking itself with the Canadian shore. The necessary authority has been obtained from Congress and from the Dominion Parliament and a charter has been granted to a joint American and Canadian company for the construction of the bridge. The plans which are herewith shown have been prepared by Charles F. Fowler, chief engineer and Dr. D. B. Steinman, his chief assistant.

The principal characteristics of the bridge are as follows. The center span will measure 1803 feet from center to center of towers, and each shore span will be 925 feet in length from center of tower to face of the anchorage. The floor of the bridge between the towers will be suspended from eight cables, and between the towers and the anchorages it will be carried upon a series of steel piers. The height of the main towers from their bearing on the piers to the center of the upper cable will be 330 feet.

The traffic over the bridge will be accommodated on two decks. Upon the upper deck will be two 7 foot sidewalks and two 28 foot roadways, the total width over all of the highway deck being 97 feet. Upon the highway deck will be two trolley tracks and on the lower deck will be four railway tracks which will be arranged to carry electrically-operated trains. In the center of the lower deck will be an open space 20 feet wide for the accommodation of such public utilities as electric cables, gas mains, water mains, et cetera. The depth of the stiffening truss is 50 feet.

An interesting feature in connection with this great structure is the provision which has been made for building first as many of the cables and such of the steel work as are necessary to carry merely the highway and electric car traffic. Subsequently when arrangements are completed for full railroad service across the bridge additional cables will be built and the floor and the stiffening trusses will be strengthened by the addition of the steel which will be necessary for that purpose.

By referring to the drawing showing a cross section of the floor system it can be seen that eight cables are provided and that they are of different sizes. Six of these are 21 inches in diameter and two are 18 inches. At the center of the bridge four of the 21 inch cables are a few feet above the level of the upper deck and the two 18-inch cables and two 21 inch cables are several feet above the level of the lower deck. Also it should be noted that these four last named cables have a deeper dip or sag than the upper floor as will be noticed in our skeleton elevation of the bridge. Where the cables pass over the towers the four upper cables are attached above and independently of the lower cables.

Now it will readily be understood that the loading of the lower deck with its four lines of railroad trains, engines, et cetera, is far heavier than that of the upper deck. Consequently in constructing the bridge to carry only the lighter load of the highway and trolley traffic it will be sufficient to string only two 18-inch and two 21 inch cables, the other four being omitted. Furthermore the stiffening truss as built to carry only the highway traffic will be very much lighter both in its top and bottom chords and in the diagonal web bracing. By referring to the diagram showing one of the trusses and a chord section it will be seen how the problem has been worked out. The full lines in the truss diagram represent the material that will be built into the truss for carrying highway traffic, and in the chord section only those portions which are shown shaded will be built. Later when the four additional cables are added the trusses will be strengthened by inserting the diagonals which are shown dotted in the diagram and by adding the plates and angles which are shown unshaded in the drawing of a chord section.

The steel towers consist each of four posts which are placed in the same vertical planes as the four pairs of cables, there being, it will be understood, one pair of cables to each of the four stiffening trusses.

Attention will be directed to the method of stiffening the four legs of the tower against lateral distortion by the free use of arched portals. This is a new departure for a large bridge of this kind. Usually such bracing has consisted of the conventional struts and ties as in the case of the towers of the Manhattan suspension bridge. The portal system is used in the three upper tiers of panels and at the base of the towers. The space between the level of the floor of the bridge and the lower portal bracing will consist of solid plate-steel diaphragms. Each leg of the tower measures in cross section from 10 feet to 17 feet out to out and has a uniform width of six feet. An interesting feature is the footing of the towers upon the foundations. Instead of flaring out the bases of the towers and bolting them down rigidly to the foundations as was done in the Manhattan bridge, the footings are struck to a curve whose radius is the distance from the bearing to the center of the stiffening trusses. This convex curved footing rests upon a concentric concave bearing on the steel foundation and is provided with rollers. The result is that as the top of the tower is pulled out of the vertical by the effects of temperature, the whole tower rocks about the trusses as a center. This means that the towers are subject only to compressive loads and are free from those heavy bending stresses which occur in a tower bolted down, as are those of the Manhattan bridge. How great is the economy of materials secured by using a rocker bearing will be understood from the fact that if these tower posts were bolted to the foundations they would have to contain twice the amount of steel in order to take care of the enormous resulting bending stresses. The maximum compressive load on either of the inner tower posts is 20,550,000 pounds under working live-load and under extreme conditions of temperature and wind pressure. The weight of the towers is about 20 million pounds.

The back stays, it will be noticed, are unloaded; that is to say the weight of the shore spans is not transferred to the cables by suspenders. Instead of this the load is carried upon four steel piers. Artistically, it is to be regretted that the shore spans are not cable-supported, but we understand that the use of suspenders was impossible because of a curve in the railway approach. Also the engineers wished to avoid large deflections in the side spans and decrease the main span deflections.

Another radical departure from accepted practice in large suspension bridges is found in the cable anchorages. Usually such anchorages consist of a large mass of masonry whose frictional resistance to sliding is sufficient to hold the cables taut. In the Detroit River bridge Mr. Fowler decided to transfer the pull of the cables directly to the underlying rock, thus dispensing with the usual massive anchorage. The cables, it will be seen, are attached to a steel bearing at the top of an inclined steel strut which is carried down to a footing upon solid rock. The pull of the cables is transferred by a series of eye bars down to an anchorage plate which is set deep within the underlying rock. All of these eye-bars are two inches thick by 16 inches deep. For the 21 inch cables there are alternately 30 and 31 eye-bars and for the 18-inch cables there are alternately 21 and 22 eye-bars. Transversely to the axis of the bridge at the point where the cables, eye-bars and struts meet, there is formed a massive concrete block 130 feet in length and of the cross-sectional form shown in our drawing. This anchorage block serves to tie the four strut frames together, but no reliance is placed upon it for resisting the pull of the cables. Both the struts and the anchor chains are enclosed in shafts of concrete which thoroughly protect them from corrosion and to a certain extent act as a reinforcement of the anchorage.

The articulated anchorage carried down to rock which will take the place of the usual massive masonry anchorage

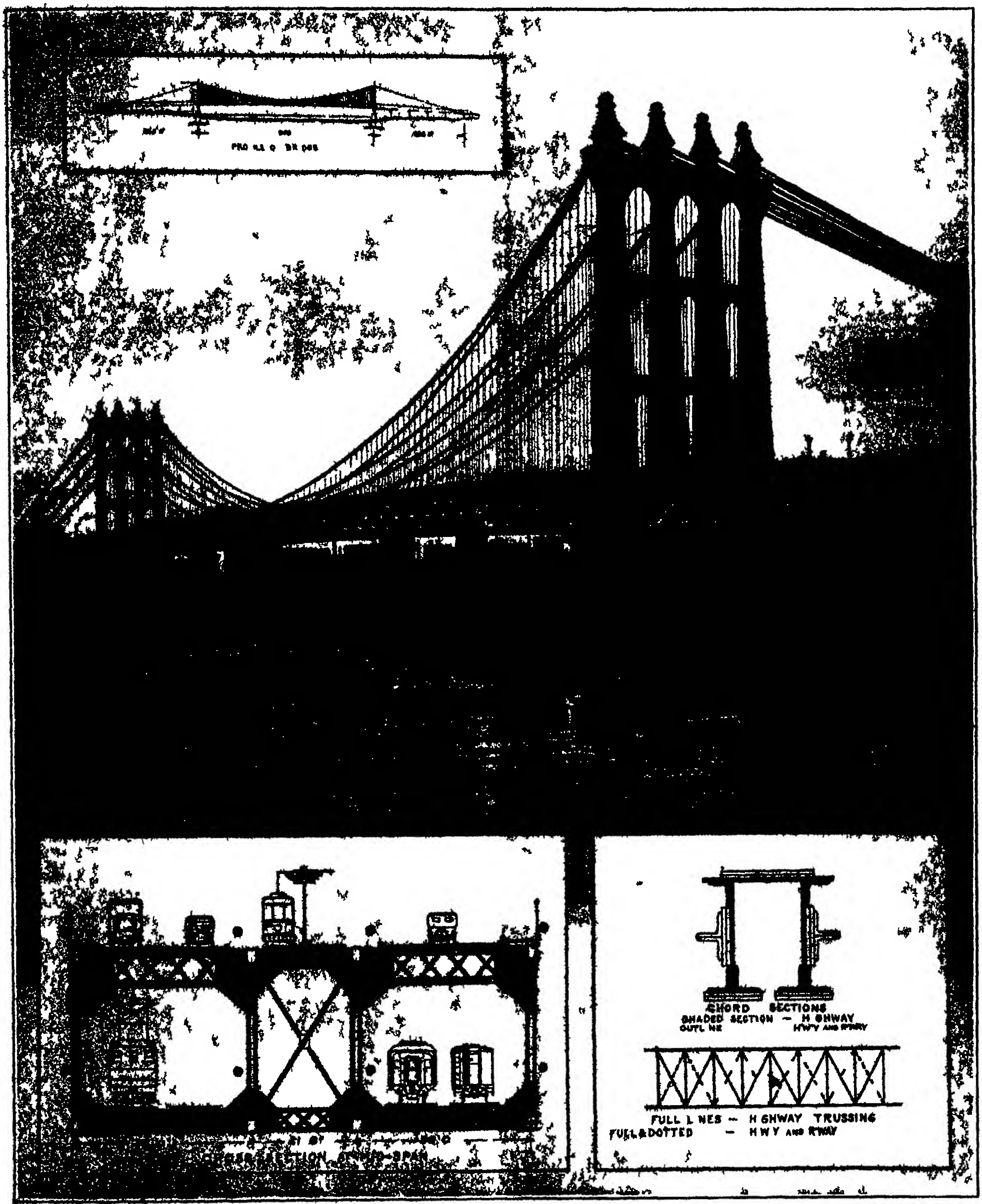
Gears of a New Material in Place of Steel

WORM wheels or gears of a new material is a recent development. Such wheels have mainly been made of steel or iron or bronze, but now for certain purposes and under certain conditions they are being made of duralumin. This alloy while not used recently has never before been used as gears. Duralumin is an alloy of aluminum, magnesium, manganese and a little copper and its strength and toughness can be made equal to mild steel and for a given section the weight is one-third that of the continental bronze. Superior strength in the teeth is assured by its alloy's tensile strength and elastic limit.

The same properties that make duralumin a suitable and desirable material for worm wheels also make it valuable for spur gears and other gearing. It is suitable as worm wheels where the pressures are sufficiently within the elastic limit of 30,000 pounds where this addition is not it replaces iron, steel, brass, etc.

Where duralumin can be run with steel rather than against itself the best results are obtained. For example, in the timing gear trains of automobile motors where both long life and quietness are essential. Helical cut spur gears of duralumin alternated with steel gears have been in successful service.

Duralumin gears when used with steel gears are quiet, which seems about paradoxical since all duralumin forgings, when struck a blow, are resonant. This is probably explained by the difference in pitch and the sound vibrations of steel and duralumin, but only true when the mass and section of the duralumin gear are properly proportioned to the steel gear.



THE PROPOSED SUSPENSION BRIDGE ACROSS THE DETROIT RIVER, WHICH WILL PROVIDE AN INTERNATIONAL RAILROAD AND HIGHWAY BRIDGE BETWEEN THE UNITED STATES AND CANADA MAIN SPAN 1808 FEET CAPACITY UPPER DECK, TWO SIDEWALKS TWO 28 FOOT ROADWAYS; TWO TROLLEY TRACKS LOWER DECK, FOUR RAILROAD TRACKS

The Latest African Anthropological Find

The Broken Hill Skull May Prove That the Human Race Started in Africa

By A. A. [illegible]

AN ancient skull has recently been found at the Broken Hill Mine in Northern Rhodesia in a bone cave some 140 feet below the original top of the hill and near to the whirling wire cables of the mine. The bone cave was already famous for its stalactites and stalagmites. The skull was found at the farther end of the cave by a New Zealand engineer whose trained eye immediately recognized the importance of the find. Unfortunately the laborers are not archaeologists so we have to chronicle the loss of the major part of the skeleton, but a leg bone, the collar bone, portion of the shoulder blade, part of the lower jaw and other fragments which have enabled the experts of the British Museum to arrive at very definite conclusions. It is of course perhaps premature to say that this is the oldest known human remains extant, but it seems assured that it is more ancient than the Neanderthal man, and it opens up the question as to whether the human race may not have originated in Africa and migrated to Europe before there was any Mediterranean. The best presentation so far of the find is in *The Illustrated London News*, and we are indebted to that journal for advance pictures and information. *Nature* and *Discovery* have also added their quota of information.

The brain-case is of modern human type and the bone not thicker than that of the ordinary European, says Dr. Woodward; the capacity, though not yet accurately determined, is clearly above the lower human limit. The orbits are large and square with pronounced overhanging ridges much extended laterally. The forward position of the foramen magnum indicates that the skull was poised on an upright trunk. The palate is large but typically human and adapted to perfect speech. It is remarkable that the teeth are much affected by caries. The lower jaw must have been massive and larger than the Heidelberg jaw. The appearance of flatness of the frontal area suggests a comparison with Pithecanthropus erectus. Dr. A. Smith Woodard was inclined to find the nearest approach to the Rhodesian skull in the Neanderthal type from La Chapelle aux Saints in France. Though markedly modern in regard to the brain-case in its facial characters, while it is essentially human it appears to hold a position between the gorilla and Neanderthal man. Fragments of the long bones, both femur and tibia, which have been found indicate that unlike Neanderthal man Rhodesian man walked in a perfectly upright posture. Dr. A. Smith Woodward regarded Rhodesian man as possibly a later development than Neanderthal man, but Prof. Elliot Smith suggested that he might represent a primitive type of which Neanderthal man might be a highly specialized form.

Thirty years ago the most ancient human remains that had been excavated were those of the Neanderthal men found in various parts of Europe. But in 1894 the remains of a far earlier type, Pithecanthropus erectus, were unearthed in Java by Dr. Dubois, a Dutchman, and these were assigned to the Pliocene Age, whereas the Neanderthals probably existed in the Middle Pleistocene or last Glacial Age. Dubois' find was, in fact, hailed in certain quarters as the 'missing link' between man and ape, but most prehistorians have since agreed that this belief is impossible. Further examinations of the Rhodesian skull have yet to be made, but it is very doubtful whether they will prove its priority in age of the Java remains of Pithecanthropus erectus.

Sir Arthur Keith of the Royal College of Surgeons says: "The Rhodesian fossil skull does not represent a type of man which is new to anthropologists; every feature of this skull proclaims the ancient African of whom it formed part to have been first cousin to Neanderthal man, that pre[illegible] of humanity which lived in Europe thro[illegible] phase of the Ice Age.

"It can not be said that [illegible] of fossil man has taken the anthropolog[illegible] by surprise. From time to time during the last [illegible] travelers and local archaeologists [illegible] the find of Palaeolithic stone implements in South Africa, in workmanship not unlike the implements found in the gravel and terrace deposits of Europe. The presence of such flint implements is a sure [illegible] that man is an ancient inhabitant of South Africa. Then, again, an ancient skull, far beyond the modern average in the size of its brain cavity, was unearthed at Boskop, in the Transvaal, just before the war. Although this skull is modern in its chief features and certainly Negroid in its affinities, yet it differs in important details from all known skulls. Then again, in South Africa we find the most aberrant of all living human types—the Hottentot, and the pygmy or dwarf race, related to the Hottentot—the Bushman. No one who had noted all these circumstances can have been surprised by the discovery now made. We may hope that Africa will yield many ancient documents relating to the prehistory of human races.

"Can anything definite be said regarding the date at which the Neanderthal type or species of man flourished in Europe or Africa? Professor Marcellin Boule, the leading authority on this matter, assigns Neanderthal man in Europe to the period which saw the last great extension southward of the ice-sheet. In England the opinion which finds acceptance at the present time places this phase of the Ice Age between thirty and fifty thousand years ago. As regards the Northern Rhodesian man the date does not appear to be so remote. Dr. A. Smith Woodward has observed that the remains of the animals which are found in the same subterranean channel as this remarkable human skull are not those of extinct species but are remains of species now living in Africa. In Europe the remains of Neanderthal man are found with those of species which have become extinct or ceased to live in Europe. In Europe Neanderthal man seems to have appeared suddenly and, after holding sway for a long period, to have as suddenly disappeared, being replaced by Europeans of a modern type. As to where and when mankind of the modern type was evolved the present discovery throws no light, but it does open out and illuminate the ancient world of that very remarkable species of humanity—Neanderthal man."

The question of the "Bone Cave" is particularly interesting. The mine is at present an open quarry, and the "Bone Cave" has been famous among geologists for a number of years. It was at the foot of this "Bone Cave" that the skull and other human bones mentioned were found, constituting the only human remains out of the many hundreds of tons of bones that have been removed during mining operations. Fossilised and partly fossilised remains of elephant, lion, leopard, rhino, and hippo, also of antelope and other cattle, together with tons upon tons of bones of small animals and birds, have been found. Mr. Harris has stood at a place where the "Bone Cave" has been cut through and has pulled out from the debris various fossilized bones, such as jaw bones, skulls of small animals, and teeth, all of which were destined to be passed through the smelters to obtain the metals which have replaced the lime of the bones, for chemical examination has shown that the lime has been largely replaced by the phosphates of zinc and lead.

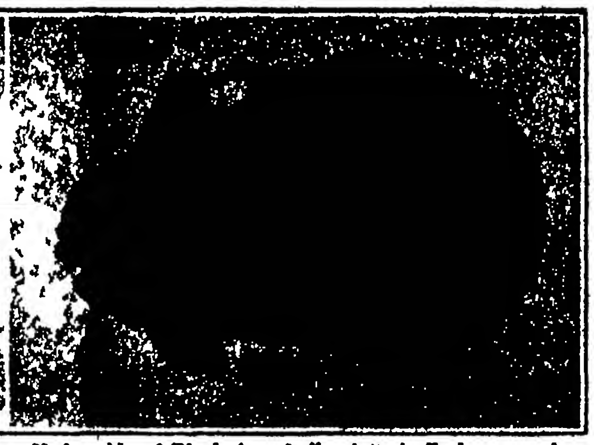
The discovery of this skull is made doubly interesting when the mine, and particularly the "Bone Cave" itself, are considered. Before mining operations commenced there stood at this spot a "kopje" or hill, 50 to 60 feet high with a slight depression in the center. Mining operations have demolished this hill, and have excavated to the depth of over 90 feet below ground level where the hill stood, and it was at this depth that the skull was discovered. The entrance to the "Bone Cave" was at ground level. One of the early prospectors, who visited it before mining operations had commenced, has described the cave as having been practically filled with debris. After one had crawled over this obstruction and stood upon the floor of the cave proper it could be seen that bones of various animals were scattered all around. The floor was made of loose debris and fairly dry. The walls and roof were studded with crystalline deposits which, when lighted up with the rays of a candle or lamp, reflected back the light, making a veritable fairy cavern, while bats and owls, disturbed by the unaccustomed lights, flew round, much to the visitors' discomfort.

"How did these bones get into this cave and how long have they been accumulating?" says Mr. W. E. Harris. "How did the skull and other bones of the skeleton, the only human remains found there, come to be at the toe of this cave, with tons upon tons of bones above them?"

"One prominent geologist has suggested that the bones have been placed in the cave by human agency. In amplification, another suggestion has been that the original cavern may have been an extremely ancient mine-shaft, which was later used as a dumping pit for animal refuse by a tribe of hunters. But the obviously great antiquity of the skull would discountenance the mining theory, while the enormous quantity (some hundreds of tons) of animal bones, and the fact that more than 80 per cent of them are so small that the animals must have been far too little to serve as food for human beings, rather tends to cast doubt on the dumping theory. The theory that these animals were engulfed while taking refuge from some natural upheaval, such as fire or flood, is likewise untenable, inasmuch as at the toe, where the skull was discovered, apart from the skull only small bones have been found. The larger bones were deposited nearer the mouth, and from their condition must have been a far more recent deposit than that of the skull or surrounding bones."

Our cover is from a painting by Mr. Howard V. Brown and shows an episode in the daily life of this early cave man. He is coming out of his primitive abode to match his human wit with the brute strength of a woolly-haired rhinoceros of the period. This illustration, as far as the reconstruction of the Rhodesian man is concerned, is taken from the drawing in the *Illustrated London News* from details supplied by Dr. A. Smith Woodward, the distinguished Keeper of the Geological Department at the South Kensington Museum, in whose charge the Broken Hill skull has been placed. As far as the data goes, we are not able to connect the Rhodesian man with hairy animals of the North, but we have no proof that men of this period did not roam in the North where they would readily have come into conflict with such early fauna.

The Rhodesian skull after cleaning. A human skull with reminiscences of an ape-like ancestor



Under side of Rhodesian skull. A typically human palate adapted to perfect speech. Photograph taken after cleaning

Artificial Cork

Waste Materials Used in Its Manufacture, and the Applications Found for It

By Ismar Ginsberg

During the past few years there have been a number of important developments made in the artificial cork industry. Thus in Austria there has been patented a process for making an artificial product from cork dust (see German Patent No. 278066). The greater part of the cork dust or cork granules is cooked first in water or a weak alkali or a water glass solution, and then allowed to remain in contact with the liquid for a period of time, varying from 24 to 48 hours. The object of this treatment is to secure a very thorough opening up of the pores of the cork. The smaller portion of the cork granules, in the meantime, is treated with a caustic soda solution and then with carbon disulfide. In this way a thick viscous solution is obtained. This mass is then mixed with the water-treated part of the cork dust, and a small amount of cork meal is also added. The entire mixture is incorporated very thoroughly with the aid of a blast of air. After the colloidal cellulose has separated from the viscous mass, the mixture is pressed in molds. There may also be added to the mixture small quantities of glue, water glass, rosin, casein and other similar agglutinants, and furthermore such fillers as saw-dust, wood flour, ground up peat, a powder made from pulverizing leaves and foliage, asbestos and many other materials of like nature.

Slipper insoles which are being freely made of artificial cork

A very good product is obtained when ten kilograms of the cork meal is cooked with water and allowed to remain in the aqueous medium for 24 hours. While this is happening, five kilograms of the meal are mixed very thoroughly with one and one-half kilograms of a caustic soda lye (containing one part of caustic soda solution, 38 degrees Be., to two parts of water), and the mixture is permitted to remain for several days in a closed vessel in a cool spot. Then four hundred grams of carbon disulfide are added, and the mixture is again allowed to stand for two more days. After this time has elapsed the cooked cork dust is mixed with two kilograms of dry meal and the five kilograms of the viscid material and the whole mass is vigorously agitated by a current of air, so as to give a homogeneous mixture. After a little glue and water glass solution have been added, the mass is pressed into sheets in the cold at 200 to 250 atmospheres pressure. Then the sheets of cork are air-dried by subsequent pressing in a hot press at 100 atmospheres pressure. One use to which these sheets of pressed cork are put is in making various sorts of floor coverings.

Washers and gaskets of cork, used by the millions under metal bottle-caps and in lubricator cups. They are equally effective when made of cork composition

Another method, the Raschig Process, was patented by a concern in Mannheim (see German Patent No. [illegible]). The mixture of cork dust and binding agent is made in the usual manner, and pressed sheets are formed [illegible] by [illegible] [illegible] of pressed cork in special molds are placed [illegible] apparatus where they are subjected to a [illegible] of [illegible] degrees Centigrade under as high a [illegible] can be obtained. The proportion of agglutinating [illegible] 30 per cent of the quantity of [illegible] used in the mixture. After a thorough mixing [illegible] obtained, the mass is placed in molds, which [illegible] pierced with holes, and subjected to a pressure of one kilogram per square centimeter. Then [illegible] the way they are, are placed in [illegible] which is furnished with steam [illegible] the air is exhausted as completely [illegible]. The [illegible] remain in this apparatus for 30 hours without heating; then the temperature is raised to 30 degrees Centigrade. After this has been maintained for about 10 hours then the temperature is raised to 45 degrees, and 5 degrees more each 10 hours. After five to six days a temperature of 70 to 80 degrees has been attained. The sheet of pressed cork is completely dried in this fashion, and a section cut through it has the appearance of natural cork. It is light in color and is very well suited for the manufacture of corks.

Another German concern has a process for making cork sheets by the use of a veneering machine. This process is covered by German Patent No. 288319. The products are well suited for making floor coverings and wall boards. According to this process, a suitable number of thin layers, which are obtained by dividing up a pressed block of cork on the veneering machine, are placed one on top of the other, and then the whole is subjected to pressure, and the pressed product is dried subsequently by heating. It is also valuable to steam the layers of the press-board before subjecting them to pressure, moistening them thoroughly in this manner. The same concern has also made cork articles from cork dust by heating and pressing. It was found best to expose the cork, during the heating process, by means of an ingenuous machine in a loose uniform layer in the absence of air. (See German Patent No. 285101.)

Cork punchings, the refuse left after bottle corks are cut from a sheet of true cork. This is a source for the conglomerated product here described

The proprietors of German Patent No. 294072 have been very successful in obtaining well made molded cork articles from cork dust by the use of heat alone. According to this process, the pieces of cork which are to be worked up into various articles are coated with a fire-resistant material, such as water glass, sulfate of alumina, lime or a mixture of these, and then heated. Another way of working is to make the article first and then coat it with the fire-resistant paint and finally heat it to 200 degrees Centigrade. The products that are obtained in this manner are solid and resistant to wear and tear.

Another method of making cork composition is to mix the powdered or granulated cork with china wood oil, form the article in a mold and then heat it to a temperature of 212 to 220 degrees Fahrenheit.

An artificial cork is made from a mixture which consists of 48 parts by weight of granulated cork, 28 parts by weight of defibrinated blood, one part by weight of turpentine and 12 parts by weight of glycerine. The mixture is made with the idea of using the cork in the hot condition. The mixture is heated and pressed into the desired form. Stoppers for bottles have been made very successfully in this manner.

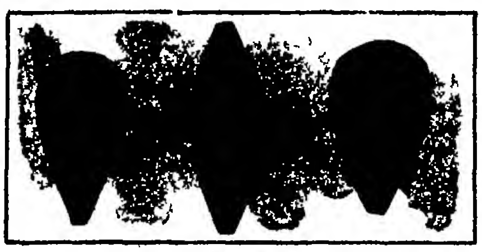
C. Lindemann patented a process (see German Patent No. 318743) in which cork stoppers are made from agaric, which is rendered resistant to moisture, acid and the drying action of the air. This is accomplished by dipping the cork speared on a fine needle, into a bath of melted paraffine. It may be said that agaric is a name given to a tree fungus which is used as tinder. More widely it is employed to indicate a variety of corky forms that grow on trees in various parts of Europe. It is in this extended sense that it is used here.

Polishing wheels of cork or artificial cork used on glassware

Artificial cork is further made from various plant fibers such as straw, reeds, wood and sprouts which are easily worked up. These materials are ground up finely and then the powder is subjected to a steam pressure of from 3 to 4 atmospheres in a closed vessel, until all the water soluble or those constituents, which first are converted into this form, are removed. Then the residue is incorporated very thoroughly with an emulsion made from soap and low melting point hydrocarbons such as bitumen. The soap is then converted into the insoluble form by cooking with lime-water or any other suitable salt. The mass that is obtained in this manner may be formed into any desirable shape, then dried at about a temperature of 130 degrees Centigrade.

Wireless Telephone Progress

Wireless telephony has of late shown extraordinary developments. We have not only succeeded in simplifying the apparatus and sharpening the tuning, but also chiefly in transmitting over larger distances. Thus, for instance, it is today possible to speak from Paris to Basle or Moscow and at that quite clearly. Even musical pieces and operas have been 'phoned across space by wireless. Trials that have lately been made in this direction have had such brilliant results that one may actually speak of a new era having started for wireless telephony. The operas "Madam Butterfly" and "Aida" sent out by the transmitting station were heard most distinctly at all stations put up around at a large distance, and like results have been attained in the transmission of musical pieces in America. As receiving apparatus has already been greatly simplified so that the costs of production have become comparatively low it has been decided to bring them now into general use. A large wireless telephone company will probably start ready by the first of the year with the lending of receiving apparatus to people desiring such. A gigantic transmission station will in future get up concerts and many thousands of persons hundreds of miles distant will be able to listen to them. Not only musical pieces will be transmitted, but also sermons, speeches in Parliament, exchange reports, etc., and everyone possessing a wireless receiver need only take up the telephone receiver and listen. The musical pieces, reports, lectures, etc., will all be sent from the transmitting station at the same time. They are, of course, unintelligible to the unaided human ear even in the station itself, for the sounds are transformed into rapid motions of the ether which are not perceptible to us. All these oscillations of the various communications have different wave-lengths so that they can not disturb one another. It is left to the choice of the listener whether he wants to hear a sermon, a concert or an exchange report. Thus speaks one of our contemporaries in describing British radio progress.



Artificial cork is of course as good as the original product for bobs and floats

Untangling Our Traffic Tangles

A Survey of What Modern Vehicular Traffic Means and How It Can Best Be Handled

By Dr John A. Harriss

Special Deputy Police Commissioner New York

THE widespread introduction of motor vehicles has done much for highway transportation. In fact the railroads with their great carrying capacity and their speed displaced the highways to a great extent up till the advent of the motor vehicle. But with the steady development of the automobile and the motor truck, the highways have slowly but surely come into their own again and today highway transportation is a powerful rival of the railroads of this country.

But the story does not run quite so smooth as I have put it. With the ever increasing use of motor vehicles, the highways of the nation have become more and more taxed until now there is an overcrowded condition on many of our highway systems. This condition is really acute in large centers of population such as New York and its surrounding cities and suburban districts. Indeed no one can deny that the automobile brought back the highways into favor and now there is no denying the fact that the highways must be developed to take care of the ever-increasing traffic if the automobile is to forge ahead.

A fair idea of the increased number of vehicles to be found on the public highways of the nation may be had, when it is considered that during the *entire year* 1920 licenses were issued by the New York State Automobile Bureau for 72,128 commercial vehicles as against 52,668 similar licenses for the *first six months* of the year 1921. In addition there has been an increase of approximately 15,000 vehicles of all descriptions licensed by New York City for which I can best speak during a comparative five-year period.

It goes without saying that such an increase of street traffic in large cities like New York has called for rigid and effective traffic regulation. In the case of New York's Fifth Avenue which handles more vehicular traffic perhaps than any other thoroughfare in the world we evolved a signal system of traffic regulation. This system which has attracted considerable attention was not undertaken until the entire traffic problem had received prolonged and deep study with special reference to congested conditions on Fifth Avenue which were so intense as to make anything like a ready and expeditious movement of traffic quite impossible.

From personal observation in the vicinity of one of the city's heaviest traffic points, namely Fifth Avenue and 42nd Street it was found that the ordinary method of handling traffic through the assignment of policemen at street intersections, even when aided by the "Stop" and "Go" semaphores, was quite insufficient to cope with the abnormal traffic conditions existing. Something really radical had to be done in order to handle the situation. And little help or suggestion could be counted upon from other municipalities for nowhere was there to be found an equally difficult problem. After considering various ways of affording relief including the establishing of a one-way regulation at certain times of the day it was decided to try out a plan of signalling similar to that in use on the railroads throughout the country whereby uniform and simultaneous movement of traffic could be accomplished.

The decision soon took shape when signal towers were erected at 57th, 50th, 42nd, 38th and 34th streets for the control of traffic on Fifth Avenue and on cross streets in the most congested area between 30th and 60th streets. These signal towers make use of signalling lamps by means of flashes, telephones and push button signals, and serve to issue the orders to the traffic officers assigned at these points and along the avenue from 14th to 110th Streets.

The present towers are temporary structures, intended only to try out this innovation and if necessary work out certain refinements. Ultimately new and ornate traffic towers will be erected the design already having been selected. The present tower floor is 12 feet above the roadway affording a clear view for the occupants. The base of each tower is designed in such a manner as to sheer off passing vehicles thus furnishing in addition to their specific purpose Isles of Safety for pedestrians crossing the Avenue.

The signals flashed from the traffic towers indicate the following orders to traffic policemen at various street intersections pedestrians, and drivers alike:

Yellow Light: Traffic moves on Fifth Avenue, while all cross traffic from side streets stops behind the building lines or white limit lines when these are marked on the roadway.

Red Light: Traffic on Fifth Avenue and side streets stops behind the building lines, or white limit lines when marked on the roadway so as to give clear intersections.

Green Light: Traffic from side streets proceeds.

The signals are in operation from 8 A.M. to 12 P.M., and serve to regulate not only the movement of vehicular traffic but also apply to pedestrians in crossing the roadways, which they are required to do at the crossings.

And what does this all mean? Simply this that whereas under the old system the traffic on the Avenue and side streets was handled by a large number of policemen stationed at the various intersections each policeman handling his particular intersection according to his own judgment, so that the entire traffic flow was a many sided affair which got in its own way so to speak under the present traffic-tower arrangement the entire traffic stream is controlled as a single unit. Traffic on the Avenue starts as a unit moves for a certain length of time and is then stopped giving an opportunity for traffic on the side streets which has accumulated while traffic was moving on the Avenue, to cross the Avenue at the various intersections. This unison of all traffic movements is virtually clocklike—and certainly efficient. Indeed, by actual test under old conditions it was found that a vehicle required as long as 40 minutes to proceed on Fifth Avenue from 57th Street to 34th Street or in the reverse direction—a mere matter of a mile or so—at certain times of the day. Under the new traffic regulation however this annoying and costly delay has been reduced by more than 60 per cent. The system has been successful beyond a doubt and has accomplished much in the way of eliminating annoying and costly delay.

Our present scheme though is by no means perfect. Here and there are little rough spots, so to speak that will have to be smoothed over. For instance it is believed that some improvement can be effected in the flashlight signal system by keeping the towers under automatic control as well as the individual control to

All Photos Copyright, Keystone View Co

Left: Fifth Avenue looking north from 42nd Street on a day when there was no especially heavy automobile traffic. *Right*: A nasty jam where the New York Central's freight artery into the city crosses Manhattan Street outside the ferry gates. A train has just cleared the crossing the automobiles are going from the ferry and the pedestrians are rushing for seats on the boat. *Above*: One-way traffic on Williamsburg Bridge, over the East River

Typical traffic conditions in Greater New York. Pictorial proof of the serious traffic problem of today

which the experiment has so far been confined.

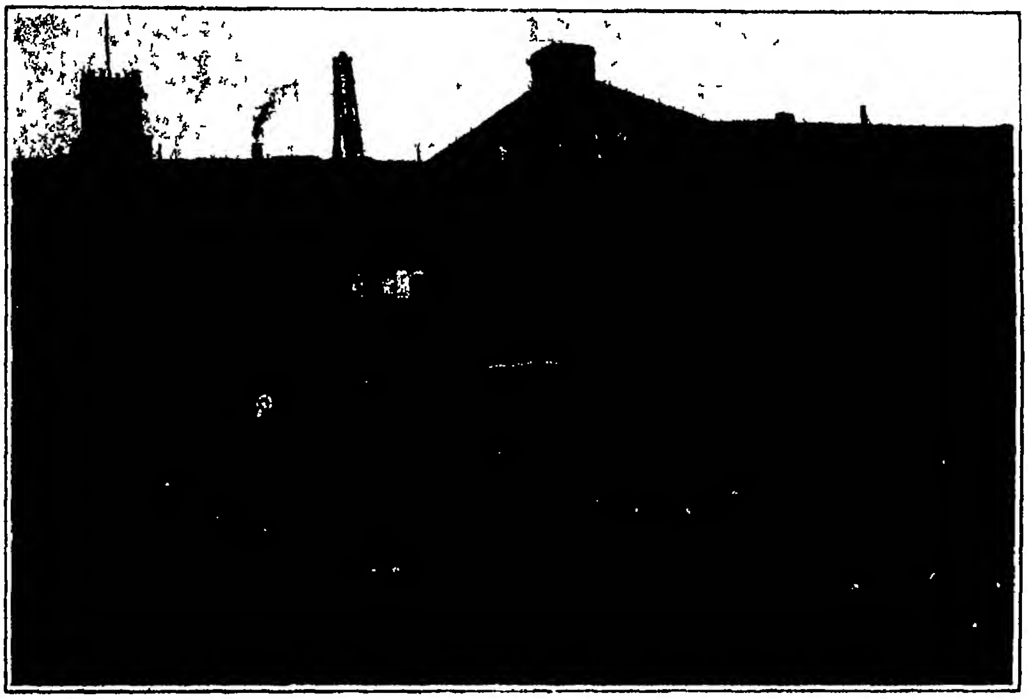
Another innovation which we have tried out with decided success in New York City is the one-way street restriction. It permits of a greater volume of traffic in a given thoroughfare than would be possible if the same thoroughfare were open to traffic moving in opposite directions. Usually where a regulation of this kind is adopted a similar one for the movement of traffic in the opposite direction is made effective on an immediately adjacent street, to avoid the possibility of inconvenience.

To increase the capacity of the East River bridges—the connecting links between New York City proper and Brooklyn and Long Island City—roadways for light vehicular traffic are in the course of construction above the main roadways of the Manhattan and Williamsburg Bridges, where bridge traffic is heaviest, and when these are ready for use the traffic capacity of these structures will have been considerably increased. In addition to this the approach to the Manhattan Bridge at the New York terminal is to be enlarged and widened, which will relieve congestion and permit of a more rapid movement of traffic in entering and leaving the bridge

The ferry situation always presents a difficult problem in these days of heavy vehicular traffic And nowhere is this problem more serious and difficult of solution than New York City proper, which is separated from the New Jersey mainland, to the west, by the wide Hudson River With the different ferryboats crowded to capacity and operating on a fair schedule there still exists the problem of expediting the movement of numerous vehicles which suffer great loss of time in crossing ferries operating from the several boroughs comprising the city of New York. On Sundays especially, the ferries are badly congested. It is no unusual sight to see a line of automobiles a half mile long in front of a ferry terminal, waiting to board a boat. It is no uncommon experience for motorists to wait over an hour in such a line. Of course, a bridge would be the obvious solution, and a Hudson River bridge capable of handling a large part of the present ferry traffic between New York and New Jersey is a future probability Larger ferryboats are also a probability, but over the short courses involved there would be little gained through the use of larger ferry units, so it seems. But the one source of early relief may be found in the vehicular tunnel now building between New York City and Jersey City The New York outlet of this tunnel will be at the corner of Canal Street and the Varick Street extension, which has already become one of the principal arteries of traffic on the west side of the city

Parking is another consideration in the study of traffic in large cities. Under the present regulations in force in New York City a vehicle is permitted to park for such length of time as does not interfere with or obstruct the ready flow of traffic In the highly congested sections of the city a maximum period of fifteen minutes is allowed, while in various parts of the several boroughs public parking spaces have been provided on extremely wide thoroughfares or open squares, where a vehicle may be parked for an extended period of time. Satisfactory results are being obtained under the present parking regulations, which, as a whole, have met with public approval.

The traffic problem is not altogether an urban one Even on, the remote rural roads traffic has become exceedingly heavy, Many of the principal country roads leading out of New York City are in poor condition and insufficiently wide to accommodate the volume of traffic passing over them. It seems to me that this condition could be relieved, without any large expenditures, if the State Highways Department widened these roadways so as to make it possible for four lines of vehicles to be operated over them at one time.



Waiting for the Manhattan Street ferry on a Sunday morning during the pleasant weather Coming back at night it is even worse on the Jersey side, the line may extend for a mile, and sometimes the jam is so bad that many drivers abandon their cars and return for them the next day

American Telephone Practice from a British Point of View

THE essential features of present American practice in telephone-line construction were described by Mr E. S Byng in a paper read before the Institution of Electrical Engineers.

After outlining the staff organization adopted by the American Telephone and Telegraph Company, constituting with its associated and connecting companies what is commonly known as the Bell System, and controlling some 12,000,000 telephone stations, he referred to the methods followed in making development studies with the object of forecasting the needs of many years ahead In the next section of the paper he discussed the design and lay-out of plant and noted among other things that means having been found of eliminating the defects that were liable to occur in aerial cable, it is now settled policy, where local conditions permit, to run all long-distance cables aerially In general it is claimed that the stability of an aerial cable route is assured by the precautions taken during installation, the chief points to be observed in planning such a route being short spans, extra short poles, removal of trees immediately adjacent to the route, suspension strand at correct tension, the right class of ring at short equal distances apart, marline ties to prevent crystallization and ring cuts, and grade clamps to avoid creeping

In the section on engineering and constructional methods he dealt with pole routes, aerial cables, conduit routes, underground cables cabling in hotels and large office buildings, block cabling and wiring, and drop wiring, and after alluding to the extensive use made of motor vehicles for the transport of materials and men gave an account of some of the mechanical and labor saving devices employed Among these are ditching machines for excavating the shallow trench required for telephone conduits back-fillers, a modified form of farmer's plow, used for pushing the ground back into the trench before running tamping machines, which will do as much work as 10 men each armed with 10-pound rammers or punners, pole-hole excavators, and pole erectors.

A pole-hole excavator consists of a three-ton truck carrying a large auger rotated at 60 r p m by the engine through gearing and capable of making a hole 18 to 24 inches in diameter up to 8 feet deep A revolving turntable on the truck enables the hole to be excavated from either side or from the rear of the truck A pole-hole 6 feet deep can be excavated in from three to five minutes in various types of soil Clay and even hard pan offer little resistance to the auger, the only serious obstacle being hard rock In a more recent type the truck is fitted with a derrick which is capable of erecting the pole on completion of the excavation. The author witnessed the erection of 45-foot poles in a back alley in Detroit by means of this equipment. The subsoil was a hard clay, and it took the machine 4½ minutes to bore a 6-foot hole, and a total of 6½ minutes to place the pole in position ready for tamping One foreman and two skilled men represented the whole gang All the telephone companies also have a number of three-ton trucks fitted with derricks for pole erection On country roads, where the poles are laid out along the road in advance and the holes have been excavated, it is possible to erect 25-foot poles at the rate of about 40 an hour under favorable conditions. The maximum number erected in an eight hour day by one foreman and eight men using one three-ton truck is 300

In conclusion the author remarked that when the speed with which telephone construction is carried out was first realized it was imagined that the quality of the work must necessarily suffer Investigation however showed that this was not the case There are several reasons for this unexpected combination of high quality and rapid output The ready acceptance of machinery and labor saving devices by the working man and the fact that they have been used to their full capacity have been conducive to high efficiency Trade unionism exists to some extent, but there is no desire to hamper output The men readily accept any suggestions for speeding up the work as they believe it will be to their advantage to reduce costs In consequence it has been possible to place the majority of telephone workmen on the staffs of the various companies rather than on an hourly basis. They receive a good weekly wage and enjoy privileges in regard to holidays, sickness, pensions, etc, which attract a good class of men Another important point is the prospect of promotion to the higher grades for all ranks It is a fact that any position in the Bell System is open to anyone who becomes qualified for it Among the jointers are men who have graduated in a university they have started at the bottom, but they do not stay there long The actual hours worked are not long but while the men are on duty they work hard and well

Making Petroleum from Colza Oil

A FRENCH scientist M Alphonse Mailhe, has been making some interesting experiments with regard to the effect of catalysers upon vegetable oils He first observed that the decomposition of linseed oil upon a mixed catalyser copper magnesia led to the formation of a gas having a high degree of calorific power and a liquid which after having been hydrogenated upon nickel at 180 degrees, was found to consist of a mixed petroleum made up of formenic and cyclic hydro-carbons with the latter predominating At a session of the French Academy held October 17 1921 he made a report stating that most vegetable oils behave in the same manner He mentioned in particular the treating of colza oil over a copper alumina catalyser in a copper tube at a temperature of 550 to 650 degrees Centigrade This treatment resulted in the formation of non-condensable gases and a liquid The gas, which has a high illuminating power, consists of ethylenic and formenic carbides and of hydrogen accompanied by carbon monoxide and carbon anhydride

The liquid formed which was chestnut brown in color readily yielded two fractions one boiling at 150 degrees Centigrade and the other at 250 degrees When the residue was passed over the catalyser the second time fresh quantities of these products were formed After being treated with dilute soda and water each of these liquids was hydrogenated over nickel at 180 degrees These results show that the decomposition of colza oil under the conditions stated results in a mixture of cyclic and formenic hydrocarbons. Thus it appears that it may be possible to produce at will any given petroleum containing chiefly cyclic carbides which are either simply cycloformenic or else both aromatic and cycloformenic If the range of raw materials can be made sufficiently wide this process may aspire to a place in the future program comparable with that held by the manufacture of vegetable alcohol fuel

Overhauling the Human Mechanism

Some of the Extraordinary Things That the Twentieth Century Surgeon Has Learned to Do

By William A. McGarry

AMONG the scientific developments of the present generation none are more marvelous than those of surgery—most practical of all applied science. We recall, some fifteen years ago, when surgery inside the chest was just beginning to be practiced, that a very competent physician and surgeon patiently explained to us six separate and distinct reasons why it could never be done, and why the reports that it had been done were newspaper fabrications. What the same gentleman would say to the prospect of working for two hours within a patient's skull by the light of a tiny lamp introduced therein we can hardly imagine. Such achievements as this make it plain that the surgeon of today takes his patient apart, repairs him, and puts him together again, with somewhat the same freedom displayed by a mechanic in overhauling the internals of an automobile. This story, as revealed by the Eleventh Annual Congress of the American College of Surgeons, Mr McGarry tells us here.—THE EDITOR.

THE possibilities conjured up in the most prosaic imagination by even a casual summary of happenings at the Eleventh Annual Congress of the American College of Surgeons, held in Philadelphia recently, make an appeal of outstanding general interest. Perhaps the most amazing single item was the war-born work in facial reconstruction But at first glance the rebuilding of a human face seems a phenomenal achievement, its importance to the whole public dwindles perceptibly in comparison to some other trails that daring surgeons are blazing with encouraging success in sections of the human body almost uncharted, so far as the knife of the operator is concerned.

The brain, for instance, has been approached by the most skilful surgeons, even in recent years, with hesitancy Intra-cranial operations have been a last resort. By actual operations at the recent Congress it was demonstrated not only that this condition no longer exists, but that the specialist in brain surgery is now as sure of his ground as the bone-setter In the presence of famous surgeons from many countries of Europe and South America one surgeon, working by the light of a tiny electric bulb inserted into the hole which he had cut in the patient's skull, performed an operation consuming more than two hours.

This use of electricity is a natural development of steps taken by surgeons in earlier years. Six years ago at a Congress of the College a daring surgeon operated on a boy who was subject to fits. The ordinary diagnoses had failed to disclose any sign of a blood clot. Knowing the exact spot on the face of the child at which the contractions started, the surgeon made a small opening in the skull and with an electric needle gently touched the surface of the brain over a widening area. When the muscular contractions resulting occurred at the point where the fits always had their start, the surgeon examined the interior of the skull and found a small piece of scar tissue This was removed, and the boy recovered

Since then a famous Baltimore surgeon has made possible the definite location of brain tumors and other obstructions by X ray Until a few years ago X-ray pictures of the brain were of little value, because the fluid produced in the spine and which passes up over the brain surface and through the ventricles is of the same consistency photographically as the actual brain cells. The Baltimore surgeon discovered that the fluid could be withdrawn through a small hole bored in the back of the skull thus letting in the air, with no ill effects to the patient. An X ray plate then gave a clear impression of the brain and of a tumor or other malignant growth.

The use of an electric bulb within the skull robs cerebral surgery of one of its greatest difficulties. This was demonstrated at the Congress by Dr Charles Frazier, a specialist in this field of the profession The patient was a middle-aged woman She was wheeled into the clinical amphitheater of the University Hospital, strapped upright in a chair a position which surgeons now recognize as superior for intra-cranial operations. A steel brace held the head rigid and in position. Bandages covered all but the small area over the left temple where the operation was to be During the early stages of the operation while the skin flap was being laid back and the surgeon was cutting through tissues to the bone without disturbing essential nerves and muscles, the amphitheater was illuminated by the usual high power overhead electric lights.

The beginning of the cut through the bone of the skull was made with a small hammer and chisel. Then a drill was used. When this had penetrated the section, about an inch and a half in diameter, was cut around with an instrument similar to a pair of cutting pliers. With the orifice completed, Dr Frazier picked up a metal band like the handle of a spoon, to the end of which was the small electric light bulb This was inserted in the hole, the handle resting on the head and holding the bulb rigid Then all the overhead lights were extinguished and the surgeons filling the rising tiers of seats could see only a dull red glow in the opening of the patient's skull.

After what seemed an age, during which the fingers of the surgeon's right hand were busy within the skull as he explained to the visiting specialists each step in the operation, he moved back to permit the others to look within. He lifted on the point of an instrument the ganglia which he had been seeking. Then, when the operation was completed, an electrode was introduced into the opening until the point of it touched the motor nerve center The patient's jaws snapped shut with a click, proving that the motor and not the sensory nerve center had been isolated.

In a general way it might be said that the three years which have elapsed since the armistice have served to crystallize the information that medical science gained in the world war, so that many of the things done under the desperate stress of war are just now coming into general use. Facial reconstruction is in this class. The members of the Congress were particularly interested in the work of Dr Vilray P Blair, of St. Louis, who was consulting surgeon to the American Expeditionary Forces in France in charge of reconstruction surgery He was able to present final statistics, showing that 2600 American soldiers needed the services of this division. Of this number about 2000 were treated abroad and 600 sent home for treatment.

At the outset of his discussion, Dr Blair emphasized the importance of the work to civilian life by pointing out that larger facial defects are created by cancer operations than by battle casualties, on the average. He predicted that the results achieved in this line are opening up a new field of surgery.

"The most important part of any surgical procedure is a plan," said Dr Blair, "and the more closely and intimately this plan fits the needs of the case, the better will be the results. In reconstruction of the face, the plan should be as accurate and comprehensive as those used by the oculist, the dentist or the journeyman tailor In the creation of the plan, we should mimic the methods of the sculptor and tailor who materialize their conceptions in clay or chalk before attacking the marble or cloth.

"If reconstruction surgery of the face should continue to develop along the lines upon which it is well started, I can see no reason why in the majority of cases a really good surgeon, given a healthy patient, the feeling of an artist, the skill of an ordinary tailor and the tenacity of a rat terrier, should not produce in flesh and bone features that compare favorably with those created by the accepted sculptor or painter. But it will require special skill and training and no end of hard work.

"Until such men are trained to work in this line the results must continue to be archaic and not incomparable to the results that would follow if each man were forced to make his own clothes. Satisfaction at one's appearance has a tremendous bearing on poise and self-confidence and, disregarding battle casualties, skill in the correction of facial defects will open up a very substantial field of legislation and much-needed surgery.

"If a man, through being wounded or an accident, has lost his nose, we first make a clay cast of the face without the missing feature. This negative is then filled with plaster and a positive cast made. On this the artist works, developing the missing feature according to the best æsthetic rules. When this is completed, we have the patient's face with the built up new features in plaster. The added feature is then covered with tin-foil and a pattern is made, when the foil is flattened out. From this pattern we cut the cartilage with which we build up the new feature from the patient's body, cut it into shape and apply it to the old wound. Then a piece of adjacent skin is cut to the size covering the newly built feature, and is left joined like a flap in its old position until it begins to graft on the new structure, after which it is cut away."

Perhaps the greatest single constructive action of the Congress was the appointment of a committee that will make a complete survey of the results attained by the use of radium in the treatment of cancer and other malignant growths. This action was the outcome of an unexpected criticism from Dr. John B. Deaver, of Philadelphia. Just after being installed as the new president of the academy, Dr. Deaver said that while he hesitated to express a fear that radium will go the way of other new methods which could not stand the test of practice, the fact is that radium has failed in many cases where it was depended on. He pointed out that it is not by any means a cure-all for cancer and warned the members of the college from placing too much reliance on its value.

Heretofore the results from radium have been made known to the profession as a whole only through the energy of the individual user, or the institution in which he works. The college has created the machinery that will in effect chart the activity of every milligram of radium for every moment of its use, making annual reports. This action was particularly timely in view of the fact that great progress was made at the Congress toward the completion of the fund for the Dr John B Murphy Memorial which is to be built in Chicago. Citizens of that city have pledged $900,000 to be paid over when the college raises $200,000.

In this memorial the College of Surgeons will have its own laboratory and research center in which the problems that have baffled the greatest of individual surgeons may be placed before the composite minds of all. It is expected that the fund will be completed and work started within another year, and in that event the radium investigation doubtless will be one of the first launched. Another problem, referred to at the sessions, concerns the expected isolation of the organism in the blood which is now held to be responsible for certain forms of internal hemorrhages that have heretofore been a mystery to science and death to the victim. It was announced that experiments have been made demonstrating that this condition is caused by a germ The blood of infants stricken with the disease, injected in small quantities into the blood of adults, has caused hemorrhages. Blood transfusion from a healthy volunteer was held out as the best known treatment. Indeed, it was stated that the profession is just beginning to realize the wide range of value of blood transfusion.

Specifications for Varnish

THE present high price of varnish for all purposes, and the great variety of uses to which it is applied, both in the home and commercial work, make proper specifications for the purchase of this material a matter of great importance. The government itself is a large user of varnish for both indoor and outdoor use, and samples of all this material submitted to the various departments are tested by the Bureau of Standards.

Two publications, Circulars Nos. 108 and 117 of the Bureau of Standards, have just been issued and may be obtained from the Superintendent of Documents, Government Printing Office, Washington, D. C., at 5c per copy. They deal with specifications for water-resisting spar varnish and interior varnish, respectively The specifications are unique in that they state the requirements which a satisfactory varnish must meet, but leave to the manufacturer a very wide latitude in the preparation of the material. This is believed to be a step in the right direction as it allows each manufacturer to follow his own ideas in the composition of the material, the only stipulation being that it shall be satisfactory under the most severe conditions.

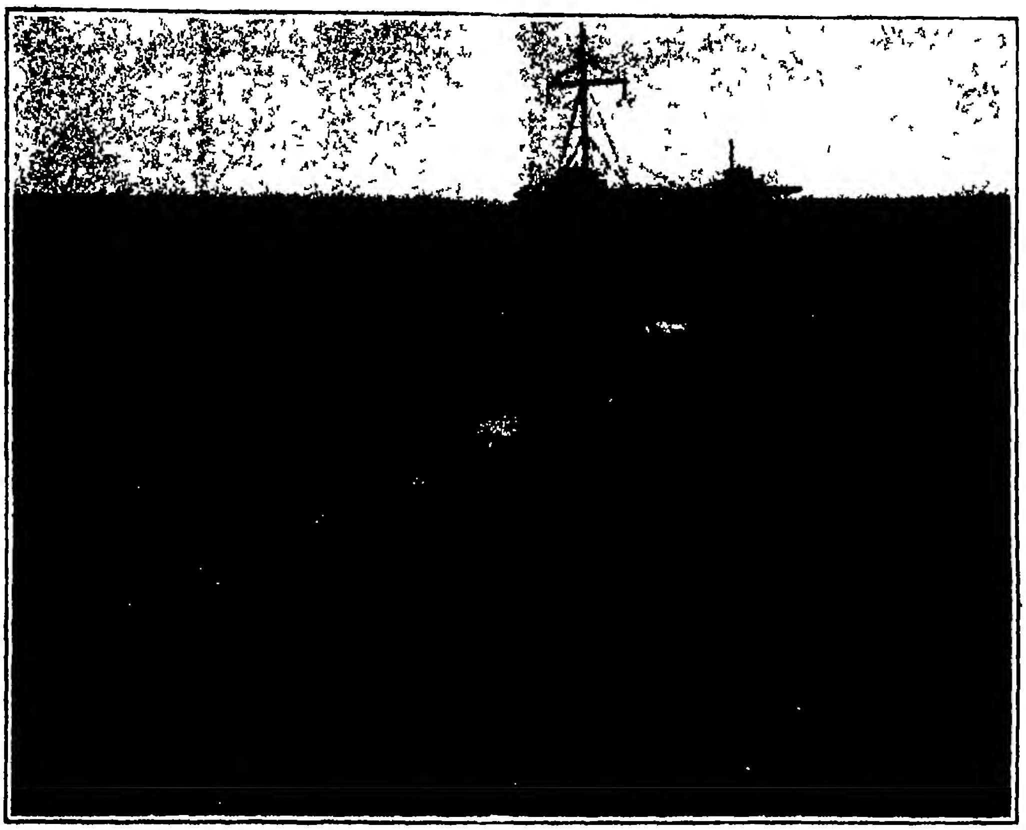
A Ten-Year Naval Holiday

Friendly Cooperation Substituted for the Present Naval Competition

SELDOM has the world witnessed an act of more courageous statesmanship than that of Secretary Hughes in his proposal that the leading naval powers should immediately destroy 66 capital ships, totalling over one and a half million tons displacement, and that no more such ships should be built for the next ten years. That this drastic proposal was an exhibition of practical statesmanship for which the whole world was waiting was proved by the acclamation with which it was everywhere received. Our Secretary realized that. The disease of naval rivalry was so deep-seated as to call for a major operation.

Charity begins at home; and nowhere did the American knife cut so deeply as into our own fleet of capital ships. This fact has been everywhere recognized. Self-surgery, such as this, prevented any suspicion arising as to the purity of our motives, and there is no doubt that it contributed greatly to the success of the Conference. Immediately upon the conclusion of Mr Hughes' address the proposal was heartily accepted in principle by the British and Japanese representatives. The subsequent deliberations have been in the direction of adjustment of details.

In working out its proposals for a limitation of naval armaments the United States was guided by four general principles. first, the practical elimination of all capital shipbuilding programs either actual or projected; second, further reduction through the scrapping of certain of the older ships, third, that regard should be had to the existing naval strength of the conferring powers, fourth, that the tonnage in capital ships should be the measurement of naval strength, with a proportionate allowance of auxiliary fighting craft prescribed.



Displacement, 32,600 tons. *Speed*, 22 knots. *Armament*: Eight 16", fourteen 5" guns. *Armor*: belt, 18"; gun positions, 12" to 18"; torpedo tubes, two 21"

"Maryland," first U. S. battleship to mount the 16-inch gun. We retain three of this class

The United States

The United States undertakes to destroy all but two of its new capital ships which are now under construction and progressing to completion This includes the six battle cruisers and seven battleships which are now under construction, but it excludes the "Washington and "Colorado," sisters to the "Maryland," which have been launched and are from 60 to 90 per cent completed. The total tonnage of these 13 ships on completion would have been 552,800

The United States also undertakes to destroy all battleships up to and including the "Delaware" and the "North Dakota." There are fifteen pre-dreadnought ships in our Navy, and their tonnage amounts to 227,740. Adding this to the total given above for the battleships and battle cruisers, we arrive at a grand total of capital ships to be destroyed of 30 vessels, aggregating 820,540 tons.

Great Britain

Great Britain undertakes to cease construction of two new battleships of the "Hood" class, which on November the 12th, 1921, had not yet been laid down, but upon which money had been expended. These two ships represent a total tonnage of 86,000.

In addition to the two ships of the "Hood" class, Great Britain undertakes to destroy eight dreadnoughts which are at present in her first line. These are the "Orion," "Thunderer," "Monarch" and "Conqueror," vessels of 24,500 tons, armed with ten 13.5-inch guns, the "Erin" of 23,425 tons and ten 13.5-inch guns, and the "King George," "Centurion," and "Ajax" of 24,100 tons, armed with ten 13.5-inch guns.

In addition to these she undertakes to scrap fifteen dreadnoughts and battle cruisers, making in addition to the "Hoods," as mentioned above, a total reduction in tonnage of 507,100 tons. The grand total of capital ship tonnage to be destroyed totals 593,100 tons.

Great Britain is not called upon to destroy any pre-dreadnoughts, having already scrapped them all to the extent of about 270,000 tons.

Japan

Japan undertakes to abandon her program for the building of ships which are not laid down namely, the "Kii," "Owari," No 7 and No. 8 battleships, and Nos. 5 6, 7 and 8 battle cruisers It should be noted that this does not involve the stopping of construction upon any ship upon which construction has already begun.

Japan is also called upon to scrap two battleships the "Tosa" and "Kaga," which are under construction four battleships, the "Amagi" and "Akagi," which are building, and the "Atago" and "Takao," which are not yet laid down, but for which certain material has been assembled.

The above involves a reduction of six new capital ships which are under construction, whose total tonnage is 254,160 tons.

Japan undertakes also to scrap all pre-dreadnoughts and capital ships of the second line, which will involve the destroying of all ships up to and including the "Settsu" This involves the destruction of 11 of the older ships, with a total tonnage of 181,228. The grand total of reduction is 435,328 tons.

France and Italy

Regarding France and Italy, the American proposals as first set forth by Secretary Hughes had to say "In view of certain extraordinary conditions due to the World War affecting the existing strength of the navies of France and Italy, the United States does not consider necessary the discussion at this stage of the proceedings of the tonnage allowance of these nations, but proposes it be reserved for the later consideration of the Conference"

The final ratio adopted for the five powers concerned was 5-5-3-1 7-1 7

Replacement After Ten Years

It is agreed that no new capital ships shall be constructed during the next ten years, except such replacement tonnage as is provided by the agreement

The tonnage basis for capital ship replacement is as follows the United States, 525 000 tons Great Britain, 525 000 tons, and Japan, 315 000 tons. Under this agreement capital ships are reckoned to be obsolete 20 years from the date of completion This, it will be noted, is five years longer than has been accepted of late years as the limit of usefulness for a capital ship. Capital ships 20 years from the date of completion may be replaced by new capital ship construction, the keels of such new construction to be laid when the ship is 17 years old, *but the first replacement tonnage must not be laid down until 10 years from the date of the signing of the agreement* The scrapping of capital ships replaced by such new construction shall be undertaken not later than the date of completion of the new construction

No Capital Ship Above 35,000 Tons

A most important reservation is that regarding the size of capital ships, which, *it is agreed, shall not exceed 35 000 tons.* The rapidly-growing size of capital ships has been one of the most alarming facts of the naval problem Under the spur of competition each navy naturally aimed to outbuild existing ships in speed gun power protection et cetera, with the result that we have moved up in the last 10 or 12 years from the 20 000-ton "North Dakota" to the 28 610-ton "Queen Elizabeth," the 32,000-ton 'Maryland" and the 43 000-ton 'Hood.' Preponderance of power gained through big displacement of the individual ship will no longer figure in future navies.

SUMMARY, SHOWING COMPARATIVE STRENGTH

	No. of Ships	Heavy Guns	Energy Foot-Tons	Displacement in Tons	Displacement in Tons, Modified by Age
United States	18	192	13,385,176	525,850	416,259
Great Britain	20	164	12,773,360	582,725	447,837
Japan	10	96	6,755,080	313,300	247,430

Auxiliary Fighting Craft

In the agreement, auxiliary fighting craft have been divided into the three heads of auxiliary surface craft, submarines, and aircraft carriers and aircraft Under surface fighting craft are included cruisers (exclusive of battle cruisers), destroyer flotilla leaders, destroyers

and all other surface types except existing monitors and unarmed surface craft under 3000 tons, fuel ships, supply ships, tenders, repair ships, mine sweepers and vessels readily convertible from merchant vessels. No new auxiliary fighting craft may be built exempt from the agreement that exceed 3000 tons displacement and 18 *knots speed and that carry more than four 5-inch guns.*

The total tonnage of cruisers, flotilla leaders and destroyers allowed each power is for the United States, 450,000 tons for Great Britain, 450 000 tons and for Japan, 270 000 tons. If the total tonnage in auxiliary *surface fighting craft* of any power exceeds today the prescribed tonnage as given above such excess need not be scrapped until replacements begin, when the total tonnage for each nation must be reduced to the prescribed allowance. All auxiliary surface fighting craft whose keels had been laid by November 11th, 1921, may be completed, but no new construction except replacement tonnage must be laid down during the period of the agreement.

Allowance of Submarines

Each power is allowed a specified total tonnage of submarines which is as follows the United States, 90,000 tons, Great Britain, 90,000 tons, and Japan, 54,000 tons.

It is possible that there will be some modification of this arrangement Both Great Britain and the United States will have to increase rather than reduce their submarine fleets, and it has been urged that such addition is inconsistent with the purpose of the Conference, which aims at all-round reductions. The agitation in favor of the total abolition of the submarine, which prevailed at the Versailles Conference, showed some signs of revival at the present Conference The argument against the submarine was based chiefly upon the possibility of some power resorting to the atrocious misuse of it, which was one of the most damning indictments against Germany in the recent war If the submarines were to be prohibited altogether it was urged, no such abomination would become possible On the other hand, it was argued that the submarine is essentially the weapon of the weaker power

Aircraft Carriers and Aircraft

The agreement assigns a specified tonnage of aircraft carriers to each navy, the United States being allotted 80,000 tons, Great Britain, 80 000 tons, and Japan 48,000 tons. If any power possesses today a tonnage in excess of this amount, it is not under obligation to scrap such excess until replace*ments begin at which time the total tonnage shall be* reduced to the prescribed allowance Airplane carriers whose keels have been laid down may be completed No new airplane carrier tonnage except for replacement shall be laid down during the period of the agreement.

Replacement of Auxiliary Fighting Craft

Cruisers that are 17 years old may be replaced by new construction but *the keels for such new construc*tion shall not be laid until the tonnage it is intended to replace is 15 years of age from the date of completion.

Destroyers and flotilla leaders may be replaced when they are 12 years old; and the same age applies to replacement of submarines. Airplane carriers may be replaced after they are 20 years of age, but the keels *of such new construction must not be laid until the ton*nage which it replaces is 17 years of age from the date of completion.

Because of the fact that naval aircraft may be readily adapted from special types of commercial aircraft, the Conference *did not consider that it was practicable to* prescribe any limit for such.

A final and very important clause of the agreement binds the parties to it not to dispose of any war vessels in any class in such a manner that they may later become combatant war vessels in another navy Further, they bind themselves not to acquire war vessels from any foreign source. Another clause looking in the same direction is that which binds the signatories not to construct any capital ship tonnage or auxiliary fighting craft tonnage for foreign account.

The last clause of the agreement refers to the merchant marine and states that as the importance of the merchant marine is in inverse ratio to the size of naval armaments, regulations must be provided to govern its *conversion for war purposes.*

Such is an outline of this momentous agreement. It bears evidence of a painstaking inquiry into the strength of the navies concerned and the responsibilities which they severally bear. The agreement has been accepted by the United States, Great Britain and Japan, and the exceptions which were taken to it were not found to present any insurmountable difficulties. By acceptance, the powers concerned have relieved the future of a fearful menace. That is the negative gain Greater than this, however, is the positive gain of the development of a spirit of confidence and cooperation among the three leading naval powers of the world.

CAPITAL SHIP STRENGTH AS DETERMINED BY THE ARMAMENTS CONFERENCE

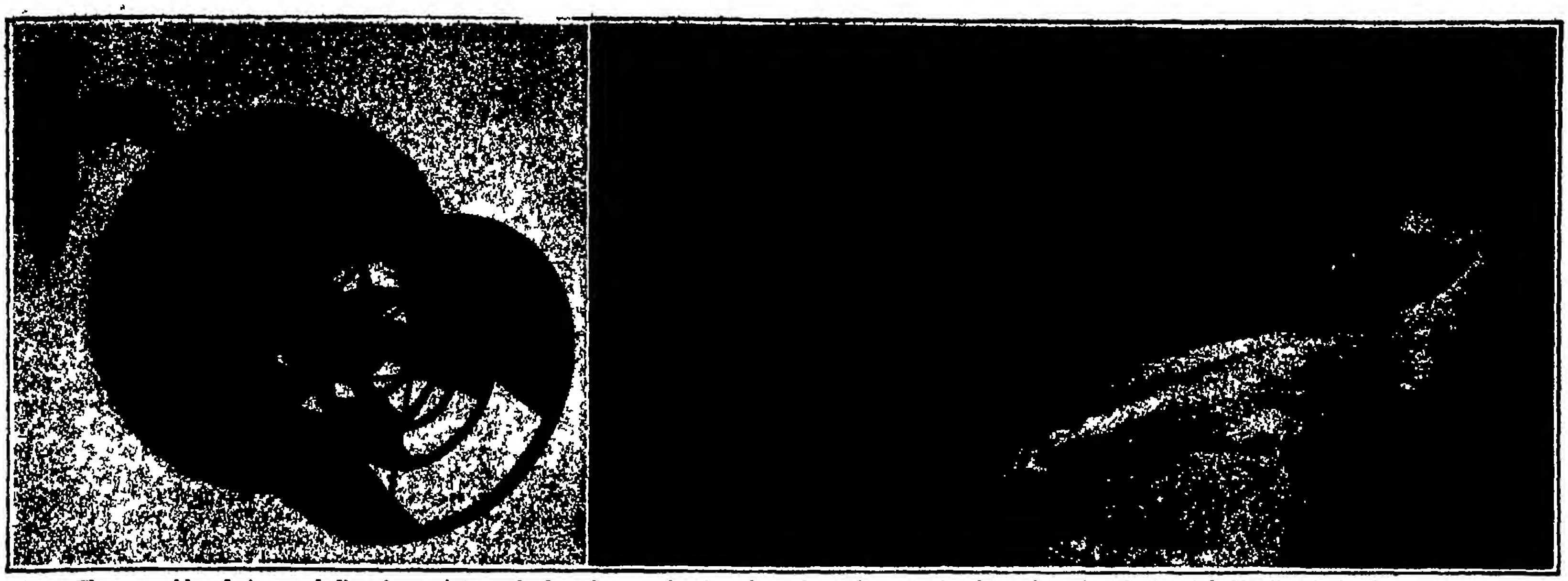
Displacement-Efficiency in Last Column Estimated on 20-Year Life Assigned by Conference

Capital Ships	Heavy Guns	Broadside Energy Foot-Tons	Date Completed	Displacement in Tons	Years Old, Nov 11, 1921	Fraction of 20-Year Life Remaining	Displacement-Efficiency as Reduced by Age
United States							
Maryland	Eight 16"	792,000	1921	32,600	0	20/20	32,600
Colorado	Eight 16"	792,000	1921	32,600	0	20/20	32,600
Washington	Eight 16"	792,000	1921	32,600	0	20/20	32,600
California	Twelve 14"	914,160	1921	32,300	0	20/20	32,300
Tennessee	Twelve 14"	914,160	1920	32,300	1	19/20	30,685
Idaho	Twelve 14"	914 160	1919	32,000	2	9/10	28,800
Mississippi	Twelve 14"	914,160	1917	32,000	4	4/5	25,600
New Mexico	Twelve 14"	914,160	1918	32,000	3	17/20	27,200
Arizona	Twelve 14"	787,272	1916	31,400	5	3/4	23,550
Pennsylvania	Twelve 14"	787,272	1916	31 400	5	3/4	23,550
Oklahoma	Ten 14"	656,060	1916	27,500	5	3/4	20,625
Nevada	Ten 14"	656,060	1916	27,500	5	3/4	20,625
Texas	Ten 14"	656,000	1914	27,000	7	13/20	17,550
New York	Ten 14"	656,000	1914	27,000	7	13/20	17,550
Arkansas	Twelve 12"	629 746	1912	26,000	9	11/20	14,300
Wyoming	Twelve 12"	629,746	1912	26,000	9	11/20	14,300
Utah	Ten 12"	490,000	1911	21,825	10	1/2	10,912
Florida	Ten 12"	490,000	1911	21,825	10	1/2	10,912
Totals	192	13,385,176		525,850			416,259
Great Britain							
Hood (modified)	Eight 16"	817,280		37,000	0	20/20	37,000
Hood (modified)	Eight 16"	817,280		37,000	0	20/20	37,000
Royal Sovereign	Eight 15"	658,400	1916	26,600	5	3/4	19,950
Royal Oak	Eight 15"	658,400	1916	26,000	5	3/4	19,950
Resolution	Eight 15"	658,400	1916	26,600	5	3/4	19,950
Revenge	Eight 15"	658,400	1916	26,600	5	3/4	19,950
Ramillies	Eight 15"	658,400	1917	26,600	4	4/5	21,280
Queen Elizabeth	Eight 15"	658,400	1915	28,925	6	7/10	20,247
Warspite	Eight 15"	658,400	1915	28,925	6	7/10	20,247
Barham	Eight 15"	658,400	1915	28,925	6	7/10	20,247
Valiant	Eight 15"	658,400	1916	28,925	5	3/4	21,694
Malaya	Eight 15"	658,400	1916	28,925	5	3/4	21,694
Benbow	Ten 13.5"	606,000	1914	25,850	7	13/20	16,803
Empress of India	Ten 13.5"	606 000	1914	25,850	7	13/20	16,803
Iron Duke	Ten 13.5"	606,000	1914	25,850	7	13/20	16,803
Marlborough	Ten 13.5"	606,000	1914	25,850	7	13/20	16,803
Hood	Eight 15"	658,400	1920	43,000	1	19/20	40,850
Renown	Six 15"	493,800	1916	27 550	5	3/4	20,663
Repulse	Six 15"	493,800	1916	27,550	5	3/4	20,663
Tiger	Eight 13.5"	484 800	1914	28,500	7	13/20	19,240
Totals	104	12 773,360		582,725			447,837
Japan							
Nagato	Eight 16"	745,840	1921	35,000	0	20/20	35,000
Mutsu	Eight 16"	745,840	1921	35,000	0	20/20	35,000
Hiuga	Twelve 14"	780,600	1918	32,750	3	17/20	27,837
Ise	Twelve 14"	780,600	1917	32,750	4	4/5	26,200
Yamashiro	Twelve 14"	780,600	1917	32,000	4	4/5	25,600
Fuso	Twelve 14"	780,600	1915	32,000	6	7/10	22,400
Kirishima	Eight 14"	526,400	1915	28,450	6	7/10	19,915
Haruna	Eight 14"	526,400	1915	28,450	6	7/10	19,915
Hi Yei	Eight 14"	526,400	1914	28,450	7	13/20	18,493
Kongo	Eight 14"	526,400	1913	28,450	8	3/5	17,070
Totals	96	6,755,680		318,300			247,430

Atmosphere a Giant Engine

IN the annual Rede lecture delivered at Cambridge, Sir Napier Shaw, Professor of Meteorology at the Imperial College of Science and Technology, said he wished to generalize the atmospheric processes in such a way as to make them amenable to established physical laws. He would regard the atmosphere as a giant steam engine A steam engine had a boiler, a condenser and a flywheel The boiler of the atmosphere was the warm surface of earth and sea the condenser some cold surfaces in the Polar regions and the great mountains, but principally the cold regions of the upper air

The flywheel was made up partly of the normal winds and partly of the semi-permanent winds of cyclonic depressions. The normal winds grouped themselves into two great circulations—on one hand a great circumpolar circulation in the upper air in which air traveled from west to east, and, on the other hand, a comparatively narrow equatorial belt of air continually passing westward. Between the two, over the great oceans, were permanent anticyclonic circulations, huge traveling bands of air, a couple of thousand miles long (west to east) and a thousand miles wide (north to south) They reminded one of the driving belts of the war tanks in their movements. As they moved round like a driving belt they carried forward the westward moving air of the equatorial circulation on the south side and eastward moving the air of the polar circulation on the north side. They were thus the gear that kept the main flywheels in working order He attributed much importance to this aspect of the flywheel. It was what long-distance air travelers will have to take chiefly into consideration in the future. By taking advantage of the equatorial portion in the fifteenth century Columbus reached America, and similarly, in the twentieth century, by taking advantage of the circumpolar section, Alcock crossed the Atlantic in an airplane in 16 hours, thus achieving the first non-stop transatlantic airplane flight.



Left: The assembly of six parabolic mirrors into a single reflector, showing the universal suspension from the pole *Right* A half-mile of illuminated road, along which objects stand out in a silhouetted outline sharper than that displayed in ordinary daylight

The Last Word in Illuminated Highways

An Invention That Calls for the Reversal of a Recently Expressed Editorial Opinion

By J Malcolm Bird

MOST automobilists will agree that on the basis of past experience the opinion which I set forth editorially in our issue of Oct 1st, 1921 is correct I pointed out that so far as successful illumination of the road is concerned one's headlight is superior to pole lights at the side of the way Everyone who drives at night must have had experiences, startling if not actually leading to accident, which illustrate this. One drives through alternate zones of illumination near the poles and semi-darkness between them until one's power of eye-accommodation is paralyzed, and the alternation of dazzle and darkness becomes a menace to safety And one's headlights, which are uniform and agreeable in the illumination they afford, are useless, the pole lights interfere with their action and leave the road substantially unilluminated. The morning papers of the very day on which I write tell of a driver in whose behalf the strongest presumption of competence and careful driving exists, who was killed on a lighted thoroughfare by running into a truck standing without tail-lights I have had the narrowest escape from a similar accident, being saved only when the headlight of an approaching car—fortunately a grossly illegal one—threw the obstruction up in silhouette On an illuminated highway of the familiar type I think there is no argument against the proposition that visibility is dangerously low So in view of the effective work that has been done to meet the problem of glaring head-lights, I expressed the definite preference for a road wholly unlighted save for such specific indication of acute danger spots as might seem desirable.

It is easy enough to locate the reason for the unsatisfactory character of road lighting as practiced. Most illuminated roads are lighted because they are really streets. Either they run out into the country as a continuation of some important city street, like the Albany Post Road out of New York, or else they form a common main street for a series of towns and cities like those that line the Central Railroad of New Jersey from Elizabeth to Somerville, or the New York-Boston route practically all the way into Bridgeport. In either event the lighting of the country stretches has grown up as an offshoot of the lighting of the built-up sections, the same principles have been applied, where in reality they do not at all apply

In the first place, city streets develop crossings every 200 feet or so, where at the very worst we have lights shining through from both streets and affording double illumination, and when often we have extra lamps traffic markers spotlights illuminated buildings, etc In the second place along city streets the line of houses is more or less continuous and while the reflection factor is far from 100 per cent it is by no means zero In the third place the curb marks a definite tangible and unmistakable limit of navigability on the one side while the center of the street is often marked by car tracks or other means and there is always light enough to see these marks. Finally, the effective width of the city street is usually far more than that of the road even of the road that is considered worth lighting.

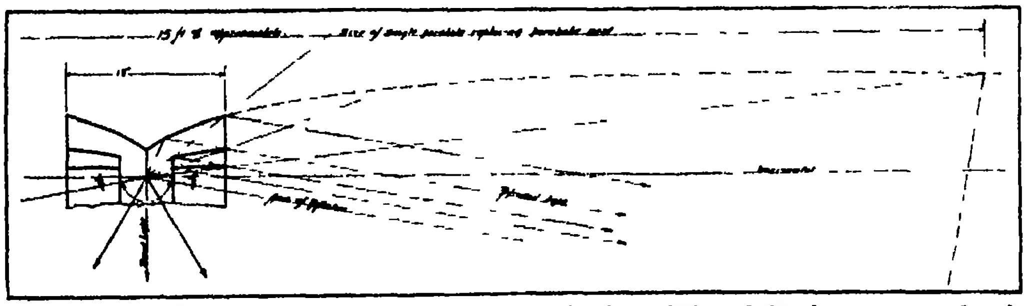
As we go out into the open country all these factors disappear yet the character of the lighting is modified in no wise save that the lights are probably farther apart In the bargain the way is in general less straight and less level In addition to its general decreased width it has bridges culverts, cuts and fills where the necessity for not encroaching on the side-lines is imperative and moving shadows are far more prevalent Is it any wonder that the lighting scheme that works so well in the city is a disastrous failure in the country?

Suppose we plant a pole beside the road and at its top place an electric lamp of any candlepower you please. Throwing its light uniformly in all directions, a small part indeed of its capacity is put to work upon the road It is absurdly evident that we can not light all outdoors, yet the effort to do so is absurdly prevalent.

Suppose, now, we attempt to meet this dispersion by the use of reflectors. Suppose we put a reflector above the lamp to divert downward the 50 per cent of the light that would ordinarily go up, and one behind it to cut off and utilize that half of the remaining 50 per cent that would ordinarily be directed away from the road. Our field of attempted illumination is now reduced to a mere quarter of all outdoors, but we shall have as little success as we had before We must concentrate our light upon the road and on the road alone

In a given direction from the lamp the road begins at a definite distance from the pole and ends after another definite distance As we sweep around the semicircle from parallelism with the road in one direction through actual perpendicularity and back to parallelism these distances decrease to a minimum and then increase again If the pole is set five feet back from a 30-foot road the ray that drops straight across the way must start work five feet from the pole and finish 35 feet from it It should be focused in a way that confines it entirely to this interval The ray that strikes the road at a 30-degree angle, on the other hand, must be effective over a distance of 60 feet but this does not begin until we get 10 feet from the pole No mere reflector will do all this we must have active focusing as well We must have a variable focusing that meets the variation we have exemplified, and at the same time we must have such distribution that there are no dark intervals Incidentally, it must be true distribution and nothing approaching a search-light beam with its glare

And there we are It sounds like a pretty problem and indeed it is just that The layman might be forgiven for doubting that it would have any solution, and even the technologist might well harbor an uneasy feeling on the subject But the illuminating engineers of the Schenectady laboratory were not willing to give it up they stayed with it until they found a solution. The form in which they found it bears out all we have said about the presumptive difficulty of the problem, for in order to achieve the desired results they have had to use no less than six distinct mirrors, of definite size shape and arrangement We need describe only three of these for the assembled reflector is symmetric, with the lamp in the middle



Longitudinal section of the reflector (upper half only), showing relation of the three mirrors of each half, zones of reflected and direct light, and utilization by each mirror of the light that is not used by the one outside it

The individual mirrors are paraboloids, like the one behind the ordinary headlight but they are somewhat longer extended than these The three of them are nested around a common axis and common focus and the closed ends have been cut off—truncated as the geometer would put it The mirrors are thus shaped like long narrow cups without any bottoms The necessity of this is apparent in order that all three of them may function on a single lamp without getting in each

(Continued on page 152)

Our Point of View

A Reminiscence of Marconi

THE editor of this journal recently had the unique experience of addressing an audience estimated roughly at 50,000, through the radio broadcasting service which a noted electrical company has established at Newark, New Jersey. The magic of the thing lay in the very quiet and ease of it all. Just an arm chair, an ordinary commercial telephone outfit, and quiet speech such as one would have across the table with a friend over coffee and cigars. It was natural—inevitable, in fact—that into our subconscious mind, while we were engaged in that little talk, there should come the image of Marconi as we saw him and talked with him twenty-two years ago in the pilot house of "La Grande Duchesse," an ocean steamer that had been requisitioned for the first display of "Marconi wireless" in the United States.

Marconi's apparatus consisted of a receiving and transmitting set, and a wire which led out through the roof of the pilot house to the masthead, and provided a single vertical antenna 120 feet in height. The receiving apparatus included a small glass tube (the coherer) which contained two silver pole pieces with their ends about one-fiftieth of an inch apart. Between the ends was a mixture of nickel and silver filings with a trace of mercury. Normally, because of their resistance, the filings prevented the flow of current. When the radio waves were received, the resistance broke down and the local current passed through. Marconi had arranged a small hammer, which rapped continuously upon the coherer by means of a local circuit which was closed when the radio waves passed through the metal filings. When the waves ceased, the hammer gave its last rap and the tube was left in a de-cohered condition ready for the next transmission. Messages were relayed from this station to the Bennett-Mackay cable steamer anchored near Sandy Hook lightship, and to a station at the Navesink Highlands. Both of these stations had cable connections with New York. No great range was called for since the yachts on no part of the course were more than fifteen miles from the starting point at the lightship, and the system worked satisfactorily.

On the last leg of the course when "Columbia" was leading Sir Thomas Lipton's "Shamrock I" by a margin which spelled certain victory, and there was a breathing spell for the wireless operator, who was of course the inventor himself, the writer asked Marconi whether he expected ever to send wireless messages across the Atlantic. He smiled, lifted his hand deprecatingly and said: "I have covered 170 miles in England. I am now aiming at 500, then I shall try for a thousand. Across the Atlantic? Perhaps. We shall see." If we had predicted to Marconi that, twenty-two years from that day, the speaker would be sitting in an armchair and talking to an audience of some 50,000 people, many of them over a thousand miles distant and most of them seated in the quiet of their own homes, or if we had told him that the next day the SCIENTIFIC AMERICAN would be sending a Christmas message to that intrepid explorer, Sir Ernest Shackleton, when two months out on his trip to the Antarctic—we wonder what Marconi would have said.

The First Fruits of the War

WE have gathered in the first fruits of the war.

When the Conference on the Limitation of Armaments assembled in Washington on November 11, 1921, the world was facing the two alternatives of friendly cooperation or war. There can be no doubt about that. Japan had answered our naval activity with her eight-eight program, Great Britain had laid down four great ships of the "Hood" class, the war scaremongers were busy fanning the sparks of resentment and suspicion and—well, it was the old, old story, and it could have had but one sad ending.

As our readers are well aware, the SCIENTIFIC AMERICAN has always protested against the completion, after the war was won, of our great naval program. We did so because we foresaw that our continued naval activity would reawaken that shipbuilding rivalry which, logically, should have died down when the Armistice was signed. Always we have had a profound admiration for the United States Navy—always we have endeavored to strengthen its hold upon the imagination of the country and win for it the loyal support of the people and its Congress. Following the Armistice, we would have liked to see, we expected to see, the Navy set an example of disarmament, by cancelling, or at least modifying, its great war program.

That was to come three years later, and to the everlasting credit of the Navy let it be said that, when our President and the Secretary of State called upon their naval advisers to formulate a plan of disarmament, our experts made such a sweeping reduction of our capital ship program as to put the purity of our motives in calling this conference beyond all question. With one stroke of the knife they cut out the six magnificent battleships of the "Indiana" class, the six 33-knot battle cruisers of the "Constellation" class, and even proposed to break up three sister ships to the "Maryland" that were within easy reach of completion.

The effect was immediate. No sooner was the proposal read by Secretary Hughes than it was accepted by Great Britain and Japan, and as soon as the full import of the proposal was understood, a sentiment of approval and appreciation swept around the world. "Peace hath her victories no less than War", and bright as is the roll of successes won by the skill and daring of our Navy in its famous engagements on the high seas, none was greater, none called for such self-denial, none demanded such unquestioned moral courage, and none, surely, in the years to come, will be regarded with more exalted national pride, than this victory of Peace, which was won at the very opening of the recent conference.

How complicated and difficult was the task of adjusting the three navies, and arranging an equitable assignment of ships under the 5-5-3 ratio, only a naval expert can fully appreciate. In spite of some inevitable criticism, the proposal has met with practically universal endorsement. Not even the most carping critic has dared to suggest that we have favored our own at the expense of the other two navies. The possibility of that imputation was shut out by the fact that we suggested scrapping our own fleet of battle cruisers and permitting Great Britain and Japan to keep theirs. Impartiality was shown, also, in allotting to Great Britain a twenty per cent excess of capital ship tonnage over our own, on the ground that her latest battleships were already five years old, and her whole fleet had suffered more age-depreciation than ours or that of Japan.

We have spoken of the credit that is due to the naval experts who prepared the program of limitation. But precedent to that was the masterly work of Senator Borah, who, single-handed, swung the Senate into line with a unanimous vote for the movement, and thus strengthened the hand of the President and Secretary Hughes in inaugurating the great movement which has now so nobly been consummated.

The Crying Need of the Patent Office

IT seems almost incredible that it should be necessary to reiterate the great need of the United States Patent Office to be placed upon a basis commensurate with its needs and the requirements of the country. But the appeals that have been made from time to time through the Commissioners of Patents in regard to the conditions within the Patent Office have been widely known throughout the country, and still Congress has failed to bring about the reforms that have been called for. Whether this is due to carelessness, to the rush of other business or to the fact that no particular patronage is at stake it is not for us to decide at this time. It is sufficient to say that these needs are well known to the people at large, even if they are not heeded by members of Congress, and it is to be hoped that some action will be taken to remedy the difficulties and defects of the present system. It is unthinkable that this great branch of our Government should suffer through inattention and neglect on the part of our legislators.

The plea for economy which is being exercised in so many departments of the Government need not apply to the Patent Office, owing to the fact that it holds at the present moment about $8,000,000 in the Treasury. Every year, but one, since 1862 there has been a surplus turned into the Treasury by the Patent Office. During all this time there has been but one increase in salaries to the Examiners and that of only 10 per cent. During the World War naturally the Patent Office force was greatly depleted, and since then, Congress has declined to increase the salaries sufficiently to attract men of the type that the Patent Office needs.

The difficulty with the whole system lies in the fact that it is nobody's particular business to see that the needs of the Patent Office are complied with and that the machinery of the Patent Office is so well oiled that its creaking will not be heard outside. But the time has been reached when something must be done and that something must be done very soon.

In a report made in July, 1921, by Mr. Robertson, Commissioner of Patents, it was pointed out that from July, 1919, to June 30th, 1921, "the Patent Office suffered a loss of 163 examiners. These men, who were scientifically trained and also members of the bar, have been replaced by inexperienced men, fresh from college, without any knowledge of patent law or any legal training. Moreover, the men who resigned were familiar, through years of experience, with the particular art with which they were engaged, and it takes years to train new men to their places."

During the fiscal year ending June, 1920, the Commissioner of Patents reports, there were received in the Patent Office 62,755 applications for patents, while during the year immediately following there were 84,248 applications, or an increase of 34 per cent. The trade-mark applications jumped from 8561 to 15,884, or an increase of 85½ per cent.

The Committee on Patents of the House of Representatives last June unanimously favored the enactment of H.R. 7077, designed to meet this situation. The Senate Committee on Patents also reported in favor of substantially this bill, stating in their report that "the employees of this office, to a great extent, are technical and scientific men. It has been recognized for many years that the salaries paid in the Patent Office were not sufficient to retain the kind of men that are absolutely necessary if we keep up the efficiency of the office. At the present time, the office is far behind in its work, and with existing salaries it is found to be impossible to keep an organization of trained men."

It is a well-known fact that millions of dollars are invested, directly or indirectly, in the manufacture of patented inventions throughout the United States. The number of people employed in various manufacturing plants throughout the country amounts to many millions, and still the business of the Patent Office is allowed to languish through the inertia of Congressional action. It is the height of inconsistency for the Government to spend money in an endeavor to relieve the unemployment situation when an inventor with a new, meritorious product must wait many months before receiving the initial action of the Patent Office that would justify him or his financial backer in proceeding with manufacture which may employ hundreds of idle men.

It is inconceivable that the bill which is now before Congress should not result in some effective action to relieve conditions in the Patent Office. But the apathy of members of Congress is so great that unless some

Our Point of View

move is made from without it is feared that this important bill will not be acted upon. If you, therefore, have this matter greatly at heart, it is important to write now to your Senators and your Congressman that Bill H.R. 7077 should be passed immediately.

Battle Cruisers as Ocean Liners

IT was inevitable that the proposal of the Conference to scrap our six battle cruisers should suggest the thought that they might profitably be completed as ocean liners. Were that done, their great length of 875 feet and their beam of over 100 feet would put them in the class of the largest ocean liners of the "Leviathan," "Aquitania" and "Olympic" type. Although in displacement they would be from 15,000 to 20,000 tons less than those ships, in speed, if it were so desired, they could be made greatly to surpass them. Candidly, we do not believe that this change will ever be made for the reasons, first, that, at least in the case of the more advanced ships, it would cost as much, if not more, to complete them as passenger ships, as it would to build entirely new vessels of equal tonnage, from the keel up, secondly, because they would be uncomfortable and very wet in a seaway, and thirdly, because they would not be economical in operation.

The best point in favor of such reconstructed vessels would be their safety against loss by collision. The submerged portion of the hull is subdivided into many hundred separate compartments, big and little. It might be said without exaggeration that below water there are from four to six hulls, one within the other, and each separated by a few feet of lateral distance from the one outside of it. Not only so, but this longitudinal subdivision is itself subdivided transversely by a vast number of bulkheads. The underwater projecting ledge of an iceberg that ripped open five forward compartments of the "Titanic" and sent her to the bottom, would scarcely affect the stability of one of these ships; and the amount of flooding that ensued could be quickly controlled by the ship's pumps.

It is this bewildering amount of subdivision that would be one cause of the great cost of reconstructing a battle cruiser for passenger service. To provide the passenger, baggage, mail and other accommodations proportionate to a ship of this size, it would be necessary to remove the greater part of the subdivision above referred to—a slow and costly job. Then, such transverse bulkheads as remained would have to be extended to the ship's outer shell. Indeed, we do not know whom to pity most—the naval architect who would have to design the reconstruction, or the constructing engineer who would have to carry it through.

In addition to clearing out the ship below water level, at least two, and probably three decks for passenger accommodation would have to be added. Furthermore, to make the vessel a good sea boat, it would be necessary to raise the freeboard from stem to stern. The "Mauretania" has 45 feet of freeboard forward, the "Leviathan," probably 52 or 58 feet, but the battle cruisers have only from 30 to 35 feet of freeboard. The addition of this bulk and top weight would have no ill effect upon the stability, for the reason that the heavy weights of side armor, barbettes, turrets and guns would be removed. Indeed, we rather suspect that the ships would be found to be too stiff for comfort; and their rolling in a beam sea would probably be jerky and therefore extremely unpleasant for the passengers. Furthermore, because the forward sections of the vessels are so fine, they would be extremely wet when driving into a head sea. The writer saw the "Lusitania," a fuller ship forward than the battle cruisers and with 10 feet more freeboard, bury her fo'castle deck out of sight when she was being driven to windward. What would happen to the upper works of these converted battle cruisers under like conditions? As battle cruisers, they would be immune against the impact, their barbettes, turrets, bridges, et cetera, having sufficient strength and inertia to withstand the blow. The battle cruisers were designed for 33 knots speed with 180,000 horsepower. Forty to fifty thousand horsepower would suffice to drive them at 24 knots.

Port Authority and the Hudson River Bridge

THE Port Authority was formed for the purpose of making a comprehensive survey of the problem of freight and passenger movement at the Port of New York and coordinating the efforts of the States of New York and New Jersey to this end. The recent report of the Port Authority shows with what painstaking care this vast problem has been investigated, and with one or two exceptions, we are able to give the report our cordial endorsement. We take exception, however, to the automaticqlly operated tunnel as being altogether inadequate to meet the situation and as costing a sum of money out of all proportion to the benefits secured. We take exception also to the statement that although there is a call for a Hudson River bridge for vehicular traffic, there is no such demand for the provision of railroad tracks to enable freight and passenger trains to enter Manhattan.

Looking broadly at the problem, we hold today as we have held for years past, that the first and most pressing step to be taken is to join Manhattan Island, which is the business heart of this district, with the rest of the United States. This, of course, is only part of the problem, but it is by far the greater part, and it can be solved at a stroke by the construction of a great highway and railroad bridge of the type which within the next few years will be erected across the Hudson River. The Port problem is so big that it is folly to play merely with it by the construction, now and then, of a tunnel of limited capacity, such as is proposed by the Port Authority. It would take twenty tunnels to equal the one bridge in capacity, and they would cost two and a quarter times as much.

The problem is one of handling passengers, heavy freight, and light, small package general merchandise.

The Port plan makes no provision for bringing long-distance and commuter passengers into the city. It lands them on the Jersey shore, and leaves them to make their way as best they can, by tunnel or ferry across the Hudson River. The bridge will bring the long-distance passengers into a union station in the heart of the city, and will enable commuters from New Jersey to move from their homes to the downtown districts without a change of cars.

The Port plan proposes to abandon the waterfront of Manhattan as a location for the transfer to steamships of heavy freight coming in from the southwest and north, and substitutes the Jersey waterfront in its place. The bridge, with its twelve railroad tracks and its classification yard in the Jersey meadows, provides for bringing heavy freight in carload lots across the bridge and into Manhattan, where it can be unloaded direct to steamships at the docks or into its line of warehouses extending down West Street.

The Port plan proposes to handle food clothing and general merchandise, or what is known as less-than-carload lots, by building a tunnel beneath the River and diagonally beneath Manhattan Island, and providing a series of warehouses throughout the city in which the material can be sorted either for immediate distribution or for storage. A system of electrically-operated trains without crews is to be employed. The system may be good, but it has never been tried on the ambitious scale which is here suggested. To that extent it is an experiment. Therefore, it would seem to be injudicious to commit the city to the expense of 200 million dollars which would be required to place it in full operation. The bridge scheme, on the other hand, proposes to employ a large fleet of motor trucks which, at a classification yard in New Jersey would load up with the merchandise and run directly across the bridge to the merchant warehouse or the store front to which the stuff was consigned. Furthermore, as regards heavy freight in carload lots, whether it is consigned to the city or for steamships sailing to foreign or domestic ports, the bridge scheme, instead of abandoning the Manhattan waterfront for such freight purposes, proposes to build a freight and passenger track down the length of West Street and house these tracks within a continuous stretch of warehouses, with communications extending across the street to the various piers. By this means, heavy freight could be either delivered direct to the ships or stored in the warehouses.

Germany Is Disarmed

WHETHER Germany has accomplished "moral" disarmament or not, there can be no question that she has carried out to completion the material disarmament demanded at the Armistice and at Versailles to completion. If today she were morally war-minded, and if she were not disarmed, the threat of war would still be present. But Germany, so far as any military operations is concerned, is so completely bereft of armament, that any military man, basing his statements upon the facts as they are and as they are known to be, will tell you that, for all her seven million men of fighting age, she is not only incapable, today, of military operations, but of necessity must remain so for a long period to come.

Modern war is an engineer's job. It is a matter of mechanical appliances produced on an enormous scale and wielded by a highly trained army of mechanicians. Destroy the mechanism of war and you have destroyed the possibility of war so far as a disarmed people is concerned.

Thanks to the Conference at Washington, we have laid the bugaboo of Japanese navalism. It remains for the Conference, or a similar one, to lay the bugaboo of an ever-present German militarism. The question is: Has Germany disarmed or has she not?

The answer to that question is to be found in a review of the work of the Interallied Commission on Military Control, with headquarters at Berlin, which was printed in a recent issue of the New York *Times*, in which it is stated that both in respect to munitions of war and of establishments devoted to their manufacture, Germany today is from 90 to 95 per cent disarmed. Field and heavy artillery is too bulky for successful concealment, and we have noted that occasional official reports during the past half year have stated that all of the German war material of this character is accounted for. Of the celebrated *minenwerfers*, 11,579 have been surrendered, 11,489 have been destroyed, and 90 remain. Machine guns and rifles are, of course, easier of concealment, yet the surrender and destruction of these have been on an enormous scale, including 86,505 machine guns surrendered and 84,108 destroyed, with 2397 remaining. Of rifles and other small arms, 4,460,649 have been surrendered, 4,351,627 destroyed, and 100,021 remain. We are informed that this military disarmament has extended to field bakeries, field ambulances, field printing plants, armored trains, pontoons and bridging material, that it covers, in fact, everything conceivable to the military mind.

Not only has Germany surrendered or destroyed her finished military material, but of the 7000 manufacturing plants and factories which were known to have been engaged wholly or in part in manufacturing war materials, 5000, commencing with the great Krupp plant, have been de-militarized, and of the 2000 factories remaining, the majority are small and of very limited capacity. The Interallied Commission on Military Control has done this work of industrial disarmament so thoroughly that in its opinion fully two years would elapse before Germany could begin to supply munitions of war even on a limited scale.

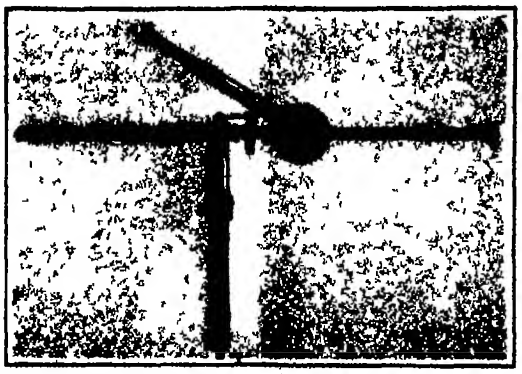
Shortly after the Armistice, we wrote in this paper that the very last thing the German people were thinking about was another war. We repeat that statement today, with a conviction which has been strengthened by the sweeping manner in which her disarmament has been carried through.

Where Human Speech Is Put On the Dissecting Table

The Remarkable Laboratory of Experimental Phonetics of Dr. Panconcelli-Calzia of Hamburg

By Dr. Alfred Gradenwitz

Sample speech-curves from the phonetic laboratory



The autophonoscope, with which the subject and the investigator are able simultaneously to see the vocal cords in vibration

A speech-curve of somewhat different character

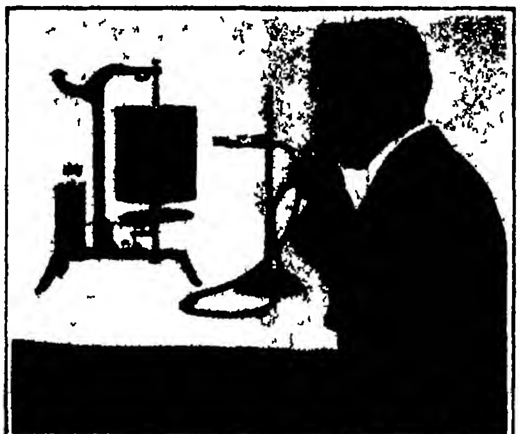
WHAT is human speech? What are its component elements and how should any one of its varieties, any language, be studied and taught? Is it a cut-and dry system of rules called grammar, governing (to some extent) its written record, literature? Can a superficial study of this artificial decoction, as commonly carried out at school, convey anything like an intimate knowledge of a foreign language? Or is it rather a living organism, something existing and growing and decaying in millions of human minds, throbbing in millions of human hearts and finding its immediate, its foremost expression, not in the literary products of a few but in the mouths of millions of human beings? The science of phonetics has developed a growing propensity toward the latter viewpoint

Though this youngest branch of linguistic science be at the same time an invaluable aid to the medical practitioner (deriving additional knowledge on morbid processes) to the psychologist (studying the mental make-up of languages), to the actor and public speaker (intent on perfecting his elocution), and to the teacher of deaf-mutes and those affected with some other defect of speech, there is but a limited number of places where experimental phonetics can be studied from some special point of view, and there is perhaps but one place in the world where this study can be carried out in the universal rather than a specialist spirit the Laboratory of Experimental Phonetics of the City of Hamburg

This unique institution is under the direction of Prof Panconcelli-Calzia, a "Roman of Rome," who after studying at German and French universities and working with the pioneers of phonetic science in both these countries, was appointed to take charge of the newly founded Phonetic Laboratory for African Languages of the City of Hamburg Under his care this soon outgrew the limited space at its disposal (occupying an entire building instead of a single room as in the beginning), just as rapidly it outgrew its original scope, until it now embraces the whole science of phonetics and its applications, in place of the mere phonetical elements of a given group of languages.

The laboratory building is situated in the center of Hamburg though in a quiet neighborhood, close to the remaining State laboratories, the Botanical Gardens and the old cemeteries. It comprises four stories with 23 rooms, of which 16 are used for experimental work The architecture as well as inner appointments are both practical and in accordance with modern fashion The basement is mainly set apart for X ray work, ordinary photography and photographic voice recording. The main floor is mainly destined for instruction, though at the same time available for scientific work The first and second floors comprise in addition to rooms for phonographic recording and reproduction, microscopic examination and the storing of records. The director is assisted by a machinist, two mechanicians, a laboratory servant and other manual helpers as well as by several volunteer assistants (at the moment under review a singing mistress a linguist, a medical specialist and a teacher of deaf mutes) On account of the wide range of work covered by the laboratory, there is a growing specialization into different departments, those already formed comprising a Phonetic X-ray Department a Cinema Phonetic Department and a Phonographic Central Station, all of which have for some time been supplying new material by scientific research work, as well as collecting and classifying the available material and giving out both scientific and practical information. The work of the laboratory is ably assisted by the publication of an international magazine, called "Vox," and which under the joint editorship of Dr Panconcelli-Calzia and Dr H Gutzmann constitutes the literary center of the young science of phonetics, publishing accounts of the best work done in all countries.

As regards methods used by experimenters in phonetics, it should be remembered that even the mere observation with the unaided ear, eye and sense of touch will supply a wealth of valuable data The ability of discerning sounds, of course, varies within wide limits from one person to the other and can best be tested by means of phonograph records, many persons, especially deaf mutes, with or without a special training, have a surprising facility for lip-reading, and the touch enables sound vibrations to be distinguished with relatively high sensitiveness.



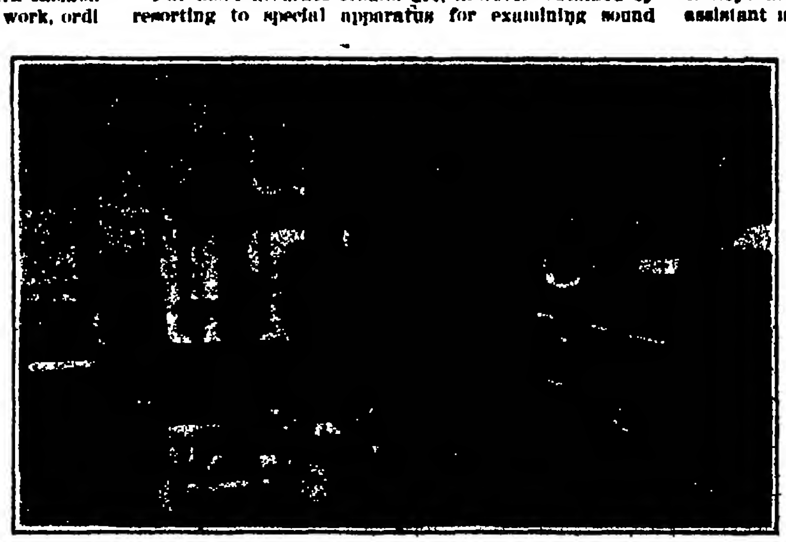
A sound recorder for phonetic research

Far more accurate results are, however obtained by resorting to special apparatus for examining sound phenomena. Some of these are for visual observation, without any recording devices. The working of the larynx, the main organ of human voice, is, for instance, with remarkable ease examined by means of Dr Panconcelli-Calzia's autophonoscope. This comprises a tube one end of which is introduced into the mouth, the opposite (eye-piece) end being intended for the experimenter. The person experimented on (or the pupil receiving a lesson of phonetics) sees his own vocal organ in the branch tube. The main tube contains a half transparent mirror The instrument also comprises a lamp and sometimes a lens system. The most conspicuous advantage of this instrument is that both the experimenter and the person experimented on simultaneously see the working of the vocal organ

An apparatus taking records of the sound vibrations constituting the human voice is the laryngograph. This comprises a small metal box coated with a taut rubber membrane and fitted with a tube as well as an adjustable recording lever The person experimented on keeps against the thyroid cartilage of his vocal organ (larynx) a capsule communicating through a leather tube with the laryngograph just described, and transmitting to it any vibrations of the sounding air-current. The recording lever accordingly traces on the rotating drum coated with blackened paper a curve characteristic of the sound vibrations.

Another apparatus in addition to vibrations also records impulses. Its recorder is coated with a loose membrane and provided with a very mobile recording lever responding to the slightest impulse A funnel is used as receiver Sounds are reproduced in the form of straight or curved lines, partly sinusoidal curves similar to those of the laryngograph

A great advance on existing methods has recently been made by Prof Panconcelli-Calzia and his colleague, Prof J Hegener by resorting to cinematographic as well as to stereoscopic records of the vocal organ, so that all the details of the latter are seen with remarkable plastic effects, as well as in the course of its natural motion



The phonographic reproduction room in the Laboratory of Phonetics

Greasing Electric Trolley Wires

THE sparking of the trolley wheel is not only annoying to the motorman and the passenger as well as to the inhabitants at night, but it is a cause of considerable wear in both trolley wheel and wire. The same statement is largely true of mining operations where trolleys are used. According to the statement of an assistant mine inspector of Kentucky, by greasing the trolley wire with a hard conducting cheap grade oil, the wheel may be caused to operate without sparks or flashing without any considerable extra expense. The singing of the wheel can not be heard when the grease is used, and the practice also saves the wear on the trolley wheel. It is said that one new wheel on greased wire will outlast a dozen on dry wire. Furthermore, it gives perfect contact and so saves power, especially on a heavy grade, and prevents sleet from accumulating on the wire. One greasing will serve under ordinary use for five or six months.

The Right of Way

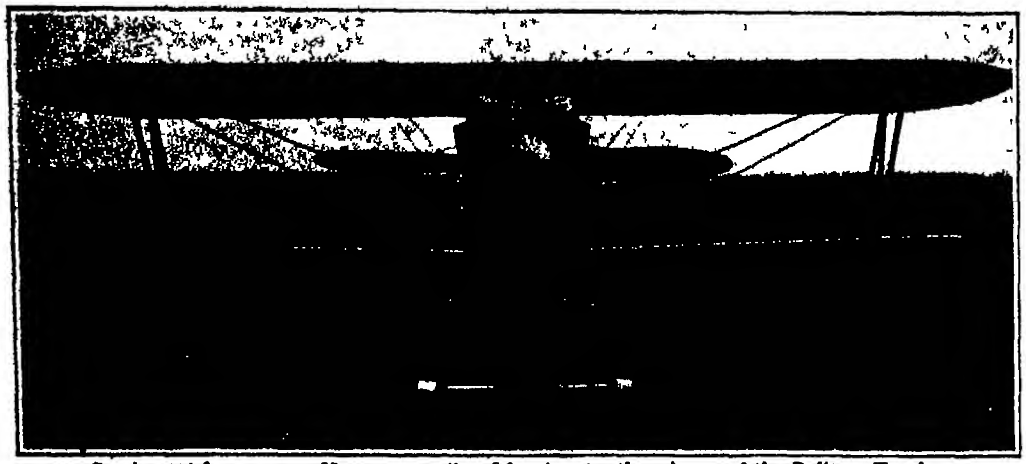
BRITISH motoring papers are conducting a discussion of the intersecting-road problem. The granting of precedence to the car on the right impresses the British mind as confusing. In its place it is proposed that the vehicle on the main road have right of way, and that when neither road is a main one, one or the other be made so by convention!

Airplane Racing and What It Means

The Immediate Lessons to be Drawn from the Pulitzer Race at Omaha

By Howard Mingos

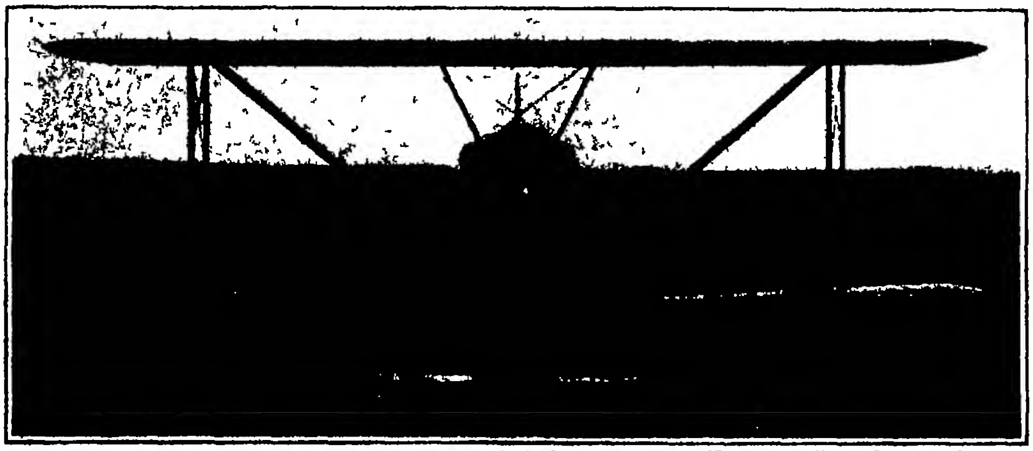
When Bert Acosta piloted the Curtiss Navy biplane across the finish line in the Pulitzer Trophy Race at Omaha, Neb., November 3rd, he had covered a course of [illegible] miles at an average speed of 176.7 miles an hour —about [illegible] feet a second— and had broken all records for speed over a closed course. That particular Curtiss entry had torn through space an average of 8.7 miles an hour faster than the Nieuport-Delage "Sesquiplane" in which Georges Kirsch had won the first Deutsche de la Meurthe Trophy and created a new world's record at Etampes, France, October 1st.



Curtiss 400-horsepower Navy racer piloted by Acosta, the winner of the Pulitzer Trophy

The Pulitzer Trophy course this year was triangular and included twelve, eleven and seven mile straightaways. This made five complete laps in the race. Acosta told the writer that on the twelve-mile straightaway, with the breeze, he had made a speed of approximately 230 miles an hour, despite the fact that an intermediate flying wire, one of the most important wires in a plane, had snapped before he had finished the first lap. This gave the daring pilot some difficulty in rounding the pylons at each point on the course, nevertheless he kept the machine at full speed whenever opportunity afforded and during the entire race did not rise more than 500 feet from the ground.

Thousands cheered themselves hoarse at the gallant performance of plane and pilot, which was not without keen competition. Clarence Coombs, driving the Curtiss-built "Cactus Kitten" for S. E. J. Cox, of Houston, Tex., who first entered the plane in the Gordon Bennett races in 1920, had an even chance with Acosta when the race began. Many believed the "Cactus Kitten" was the faster plane, faster, all points considered, by six miles an hour. Coombs, however, had never flown the "Cactus Kitten," and the plane itself had never been opened wide in a race. To the spectators it was apparent that Coombs was not able to get the most out of his machine in rounding the pylons, for he made wide turns at varying heights and probably traveled 25 miles more during the race than did the others. So great was the speed of the Curtiss-Cox entry, however, that Coombs won second place, averaging 170.26 miles an hour. Even at second, Coombs flew faster than any other had ever flown on this hemisphere.



The Curtiss racer "Cactus Kitten," owned by S. E. J. Cox of Houston, Tex., and piloted by Coombs, perhaps the fastest machine in the race, but condemned to second place by unmanageability on the turns

Among the starters who did not finish was Hartney, who was wrecked. His start was delayed by trouble with the gasoline pump, and this failed again during flight, bringing down the plane and sending the pilot to the hospital. He told me that he was making more than 200 miles an hour when the same little piece of mechanism that had delayed his departure again failed him. He tried to use his emergency gasoline tank, but so great was his speed that he could not divert his attention even momentarily without going into a spin. He knew he must land, and picked the best field available, a grass-covered plot, which proved treacherous with a slough running clear across it. Into this the plane crashed while running over the ground at a hundred miles an hour. Hartney was thrown clear of the wreckage. Now it was not motor trouble nor defective design in the plant that brought him to earth. The Wright motor, similar to that with which McCready won third place, functioned perfectly as long as it was fed with gasoline. It was the accessory, the gasoline pump, which defied the efforts of the Wright experts, who had labored with it all day to guarantee success.

That, and the fact that races in the air or on the ground are by nature, if they are real races, calculated to test to the limits—often past them—the endurance qualities of ordinary transport. That is the chief value of races—to test the capacity of all mechanical qualities. That is the practical side of sport. It is the sportsmanship displayed by racers which sets an example to the crowd. And it is this lack of sportsmanship, or rather, a retarded development in national consciousness, that so far has left to the few the task of developing American aviation. The makers of planes, as well as the pilots, are doing their share. That was demonstrated in the Pulitzer race.

But races should not be conducted without all precautions being taken. There should be provisions for forced landings. Race courses should be over available landing fields, emergency or temporary. There were few entries in the Pulitzer race because it was not scheduled earlier. Months are required for the design, construction and tests of record breaking planes. And there is little value entering planes unless they have a chance of winning. One of these days the public may be sufficiently versed in aviation to look upon the airplane as it now looks upon other vehicles, not as a curiosity to be picked to pieces when it is brought to earth temporarily helpless. And one day, if present indications justify the prophecy, we all shall fly at varying speeds of 176 and 230 miles an hour. Even to-day American designers are working on plans they confidently trust will produce machines which next year will break all records.

The S. V. A. Balilla racer with Curtiss 400-horsepower motor piloted by Bertrand; an "also ran"

New Process of Piloting Ships by Sound

The piloting of ships by means of an electric cable was one of the clever inventions of the war. The process is, however, rather expensive and necessarily fidently trust will produce locality. It is now proposed to make use of sound waves to enable pilots to estimate their distance from land. By means of the special apparatus known as hydrophones the sounds made by explosions can be heard at great distances. A bomb weighing 100 kg., for instance, can be heard to detonate at a distance of 300 km.

When a ship employing this new process is approaching land it throws a grenade into the sea and at the same time emits a wireless signal. The latter is at once registered by a recording apparatus installed at the listening post. The noise of the explosion is also recorded, but only after the lapse of a certain interval of time, which, of course, depends upon the distance. If there are two listening posts on the shore, their respective distance enables the pilot to determine the exact position of the boat. This method has been found to give results more precise than those obtained by radiogoniometric measurements. It is especially valuable in time of fog. During the war it was employed by the English monitors in bombarding the Belgian coast, which was invisible, in order to determine their exact location. The *Revue Scientifique*, to which we are indebted for these facts, predicts that listening posts of this sort will soon be in operation in England, France and Algeria.

The autoplate machine turning out stereotype plates in a daily newspaper printing plant

How an Inventor Straightened Out a Labor Tangle

One Case Where a Labor-Saving Machine Went Into Use Without a Conflict With the Men

By James H. Collins

THE technical problems solved after five years' work, and the machine running A great market waiting, and the first customer ready with his money The invention finished and successful—but a labor difficulty standing in the way of its introduction.

Many inventions must bring a shifting and displacement of workers. This was that kind of invention—the autoplate, an automatic device for making stereotype plates used in printing newspapers. And this was the situation facing its inventor, Henry A. Wise Wood, some twenty years ago, when his first machine was ready for delivery on contract.

The labor problem is human, and so are inventors, usually This inventor had the characteristic, and the problem was solved by straightforward human dealing, man to man

If there was ever a period during his boyhood when he was not familiar with the mechanism of printing, Mr Wood doesn't remember it As a youngster he had his printing press, and later published the school paper In studying engineering after that he had a definite purpose—to improve the printing art

"At its opening, the nineteenth century boasted handmade type, set by hand, and a wooden-screw hand press capable of printing two hundred 'sides' an hour," he says. "At its close, it had huge establishments turning out daily issues of many paged newspapers well up in the hundreds of thousands of copies, printed by machines of incredible swiftness and accuracy The twentieth century opened with a still greater demand for printing speed"

His first investigations were made in the field of book printing, but he quickly saw that the newspaper was the greatest vehicle for conveying information to the masses, and centered his attention upon newspaper manufacturing A son of Fernando Wood, mayor of New York City in the fifties, he knew James Gordon Bennett, publisher of the *New York Herald*, and got permission to study the technical side of newspaper making in that journal's plant. The manufacture of newspapers, he found, involved three mechanical departments—the composing room where the type was set, the stereotype room where the printing capacity of the type was multiplied by casting from it curved semi-cylindrical printing plates, and finally the press room In the composing room such inventions as the linotype and monotype had substituted machine for hand labor, and in the press room there were giant perfecting machines that automatically turned out newspapers at the rate of 15,000 to 24,000 an hour But stereotyping was still entirely a hand process The papier-maché matrices were made, the hot type-metal poured, the castings cooled and trimmed by skilled mechanics, aided by practically no labor-saving devices. A newspaper like the *Herald* at that time required 400 stereotype plates for its daily edition, and 1700 for the Sunday issue. To make them, a great many stereotypers were employed. Between the final locking up of the type pages and the starting of the presses an hour and a half was required to make the plates and begin printing, where today, by means of this stereotyping machine, the whole battery of a great newspaper's presses is working in ten to fifteen minutes after the type forms are closed.

"The stereotyping department was like a single-track bridge connecting two sections of a four-track railroad," is the way the inventor expresses it, "and everything involved in the making of a newspaper had to be crowded over that bridge."

After some weeks' study of the different operations necessary in making stereotype plates by hand, he was confident that a machine could be built to do the work—so confident that he went to Mr. Gardner I. Howland, business manager of the *Herald*, with estimates of the time that could be saved by such a machine. The newspaper man was interested at once. For already publishers vaguely sensed the remarkable expansion of both circulation and size that would be brought by the world war, and the need for machinery to meet it.

"What do you want me to do?" Mr Howland asked.

"Give me an order for a machine," was the reply.

A contract was made, the *Herald* agreeing to accept and pay $25,000 for a stereotyping machine, provided it made satisfactory plates, while the inventor was to bear all the cost of building such a device, and get nothing if it proved inadequate Wood fitted up an experimental laboratory, hired machinists, and went to work in secret on the problem It took five years to build the first autoplate, bringing it to a capacity of four stereotype plates a minute—later increased to eight. Two different sorts of mechanism were needed, one for the automatic casting of the plates and the other for trimming them to fit the cylinders of the presses.

When the device was ready for demonstration Mr. Howland was fascinated by its working—and also a little scared. There had lately been a strike over the installation of the monotype machine in the office of the *New York Sun*. This had been harmful to that paper Mr Howland was afraid that labor trouble would follow the installation of the stereotyping machine in the *Herald* plant. This contingency had been foreseen by Mr Wood and provided for in the contract, with the agreement that the *Herald* was to deal with any labor difficulty that might arise. When James Gordon Bennett was told that the new device was ready and that the labor difficulties were now up to him, he was even more apprehensive.

"I have done my work and carried out my part of the contract," said the inventor when Mr Howland demurred at putting the machine into use. "Here is the machine. Most of my money is tied up in it. It is built to the *Herald's* page size, and can not be used by another newspaper. What are you going to do?"

Face to face, the difficulty looked formidable. Howland could only suggest that the matter be settled by Mr. Bennett, who was in Paris. The prospect of negotiating such a situation by cable was not very promising. After some discouragement and delay, Wood volunteered to shoulder the difficulty

First autoplate machine, installed in the *New York Herald* plant in 1901

himself, to the relief of both Howland and Bennett, who then agreed to accept and pay for the machine if it could be installed without labor trouble.

The inventor's first step was to let the New York stereotypers' union know, indirectly, that a machine to make newspaper stereotype plates had been perfected. This report made a stir among the stereotypers, who held a meeting and appointed a committee to get such information about the device as was obtainable. The only person who had seen the machine at that time, apart from the inventor and his workmen, was Mr. Howland. The committee of stereotypers believed that any information they secured would have to be got in roundabout ways. As soon as he heard of this action Wood wrote to the stereotypers' organization, saying in substance:

"You have heard that a machine has been invented to make stereotype plates automatically, replacing hand labor. The rumor is true. I am the inventor of the machine, and should like to meet your investigating committee."

The committee came to see him, and they had a very frank talk.

"Gentlemen, this is an age of machinery," said the inventor. "Work like yours, done by hand, is bound to be brought into the machine field sooner or later. I have invented the machine to do your work. If I hadn't done so, somebody else would have invented it. It is a machine that may displace large numbers of workmen at first, but like all other devices of the kind, it will eventually make a greater demand for labor. There is no case on record of workmen opposing machines by strikes, or otherwise, and winning against them. The machine always wins in the end. When there is a strike, there must eventually be a compromise. So I thought we might get together at the beginning and see if we couldn't have the compromise without the strike. The success of my machine depends partly upon yourselves. Take plenty of time, discuss matters, and let me know what suggestions you have for installing my machine on a basis that will be fair to yourselves as well as the *Herald* and me."

The stereotypers went away impressed by the inventor's frankness, as well as the force of his argument. After another meeting of the union the committeemen asked if they might see the machine. The request was granted. When they saw delicate stereotype printing plates turned out five times as fast as they could be made by hand they were apprehensive, naturally. But fear of losing their jobs was mingled with admiration for mechanism that did their work—there could be no better audience for such a machine.

Suddenly one of the committeemen propounded a question. "What are the men operating this machine—stereotypers?"

"No, they are machinists, not one of them has ever been in a stereotype room."

"Could machinists operate this machine, then?"

"Certainly—it has never been operated by anyone else."

"What do you pay your machinists?" asked the committeeman, and when told that they got $2.75 for an eight-hour day, it was obvious to the visitors that possible rivalry with another trade was a factor in the situation to be dealt with. For stereotypers were then getting $4.50 for six hours' work. The new machine could be both installed and operated by machinists, without stereotyping experience, at a little more than half the wages.

These meetings continued over several months, and finally out of the discussions grew an arrangement with the stereotypers' organization whereby the autoplate was to be installed in the *Herald* office, and operated by *Herald* stereotypers. Three men were enough to run the machine, but it was agreed that five should form the first crew. As money savings were effected for the *Herald*, it was agreed that the stereotypers should share in this economy. Moreover, the union made changes in its constitution that amounted to adopting the machine—the inventor believes this to be the first case in history of a union taking under its protection a new labor-saving invention. Should other newspapers want to install it, the union delegated two of its members to go into an office where the autoplate was working, and there learn its operation, being paid by the union. Members also agreed that they would operate the machine in ways to make it efficient, keeping it in good repair and condition.

Against the inventor's judgment, a steel fence had been built by the *Herald* around the machine when installed in the *Herald* office, and a sign forbade entrance except to the men actually working with it. Under Wood's supervision, work was taken gradually from the hand stereotypers, the autoplate making only a half dozen plates the first few nights, then a dozen, and so on, until at the end of several weeks it was turning out more than half of the work. During that time the inventor was in the stereotype department every night, and became acquainted with every man personally. There was good feeling and confidence on both sides.

One evening, coming in about 10 o'clock, with his mechanical assistant, Wood walked into the cage and turned up the lights—only to turn them out again almost instantly. For one glance showed that his machine had been damaged. With a single lamp, guardedly they went over broken gears and working parts showing too plainly where they had been pounded with a heavy sledge. When a list of the broken parts had been made, the light was turned off.

"We must replace those parts and have everything running again tomorrow night," said the inventor to his assistant. "Phone the shop and start work at once."

Presently, stereotypers were coming in to work. The dark, locked cage attracted immediate attention. The machine had been jokingly dubbed the "iron horse."

"Why, what's the matter with the iron horse?" was asked.

"It isn't working tonight," Wood replied. "We had an accident on that last run this morning, and broke some of the gears. But we'll be all right again tomorrow. Machinery will break down once in a while—I think we've been pretty lucky so far."

Henry A. Wise Wood, inventor of the autoplate, demonstrating the working of the machine

Fortunately, the *Herald's* stereotype force was still large enough to make all the plates required. One of the *Herald's* men was president of the union. After the paper had gone to press, Wood took him aside for a talk. He had already sensed something more serious than a breakdown. Who did the damage never transpired, but it was undoubtedly the work of outside hotheads. Wood was confident that none of the *Herald* men had done the job, but pointed out to the union official that the machine must be protected. Should the *Herald* hire guards, or would the stereotypers themselves undertake this responsibility? The union official pledged the protection of his men.

The next morning Howland sent for Wood and showed him copy for an advertisement to be printed in the *Herald*, offering $10,000 for information leading to the conviction of the stereotypers who, Mr Howland said, had damaged the machine. This offer had been cabled from Paris when James Gordon Bennett learned of the trouble. The inventor insisted that the advertisement be suppressed, and as he was in charge of the labor situation, his wishes were respected. At first Mr. Howland refused to do it, saying that he must find the members of the *Herald* crew who had done the damage. To this Mr. Wood replied that he himself would vouch for the fact that the *Herald* men were straight, loyal fellows who would not commit such an act.

"Leave the matter to me and forget it,' finally said Wood to Howland.

"All right,' assented Howland.

"Now will you do me a favor?"

"What is it?"

'Take down that cage today, and the sign—I don't like them."

"What? I was going to put a police guard in it tonight! However, if you will take the responsibility, I'll pull down the cage."

"All right," said the inventor.

News of this advertisement and its suppression were not long in reaching the *Herald* stereotypers, who that night came to the inventor to thank him for intervening to save them from the suspicion such an advertisement would have cast upon them. The steel cage was taken down and all were invited into the enclosure.

These steps improved good feeling to such a degree that there was never any more damage or trouble. Stereotypers saw that the autoplate was not a makeshift but a practical device. It had been pointed out to them that it would lighten their hot, heavy work, enabling them to use their mechanical skill and their heads to better advantage, becoming supervisors of machinery instead of working as machines themselves and increasing their output and earning capacity. These promises were now realized. This union had always had excellent relations with employers, and was proud of its foresight in helping make the transition from hand to machine work instead of opposing it. In a few weeks all the *Herald's* stereotype plates were being cast by machinery, and delegates of stereotypers from other newspapers were working to acquire the experience needed to make the same transformation elsewhere.

There was practically no loss of employment. The growth of the *Herald's* work was so great, because of this machine, which made rapid publication so easy, that in a short time more stereotypers were employed in the *Herald* office than ever before. Once when a visitor asked the foreman how many men would be required to produce by hand the 2300 plates being made that night by 18 men, he calculated that it would require 75 at least.

From that day to this there has been only one strike against the autoplate, which occurred when the machine was first introduced in Europe. On that occasion the inventor went abroad and settled the difficulty in a few hours. He was invited to do this by union officials on the other side, and carried a letter from the stereotypers in this country.

When the first autoplate was installed in New York the stereotypers union had about 200 members. Today it has 650 stereotypers and finishers at work, in addition to 350 electrotypers, a striking illustration of the fact that labor saving machinery ultimately does increase employment by increasing output. Any prospect of going back to hand drudgery would be vigorously opposed by stereotypers themselves. In the old days a newspaper stereotyping room on hot summer nights came as near being an inferno as the stokehold of a steamer going through the Red Sea. It was nothing unusual for three or four men to be overcome by heat every night. Burns and strained muscles were common, and so was poisoning by lead and antimony fumes from the type metal. Today the "iron horse" does all this hot, heavy work automatically, casting stereotype plates from metal heated to 600 degrees against the 750 degrees necessary in hand casting. Instead of lifting hot metal and plates, machine operators simply pull levers, and a newspaper stereotype room in summer is now as cool and pleasant as any other department of the plant. So this invention besides being useful was merciful as well.

Alfalfas

As a result of investigations, an account of which is contained in the *Journal of Agricultural Research* for July 15, 1921, Messrs. R. A. Oakley and H. L. Westover of the Bureau of Plant Industry, Washington, D. C. conclude that it is the day-night relation of alfalfas and not their reaction to temperature that causes the development of marked differences between the seedlings of the various varieties when seed is sown at certain times of the year. By the proper control of the length of day, which can be accomplished in the greenhouse at any time of the year with little trouble or expense and by the method used in the authors' experiments, it is easily possible to distinguish between seedlings of the commercial groups of alfalfas. The tests can be so quickly and easily made that the method is offered especially to Experiment Station workers and those engaged in alfalfa-seed certification work as a means of assisting in the identification of the various lots of seed.

Corrosion Investigations

Some of the Controlling Factors, and How Account Is Best Taken of Them

By D. M. Strickland

ANY experiments which result in a better understanding of the influences governing the corrosion of iron and steel are of great value, not only to manufacturers but to users of ferrous metals as well. Testing societies, governmental laboratories, research organizations, and interested individuals are continually investigating this problem from many angles.

There is no doubt but that the corrosion resistant properties of the many present-day commercial grades of iron and steel differ widely when subjected to the various conditions of commercial requirements. Chemical purity, degasification, scientific annealing, freedom from slag inclusions, proper application of protective coatings, and exacting care in all stages of the manufacturing process are factors which undoubtedly tend toward the production of the most satisfactory corrosion resistant product.

From time to time non-technical investigators desire to conduct tests under their personal observation. These notes are submitted as an aid to their study and contain suggestive procedures for corrosion test investigations.

Scientifically controlled corrosion investigations are valuable indicators of the service life of ferrous metals. It is essential, however, that all tests be carried out under exact uniformity of test conditions. This is true for both atmospheric investigations and accelerated laboratory immersion tests. All grades of material under test must receive the same preparatory treatment and be subjected to like conditions.

The following paragraphs do not in any measure tell the whole story of corrosion test conditions, yet they will be of value, in that they bring to attention many essential factors.

An atmospheric corrosion test is usually conducted in the following manner. The full size sheets which are chosen are uniform in length, width and gage. Sections of sheets are not recommended for outdoor tests, as the results obtained on small samples are non conclusive and open to question.

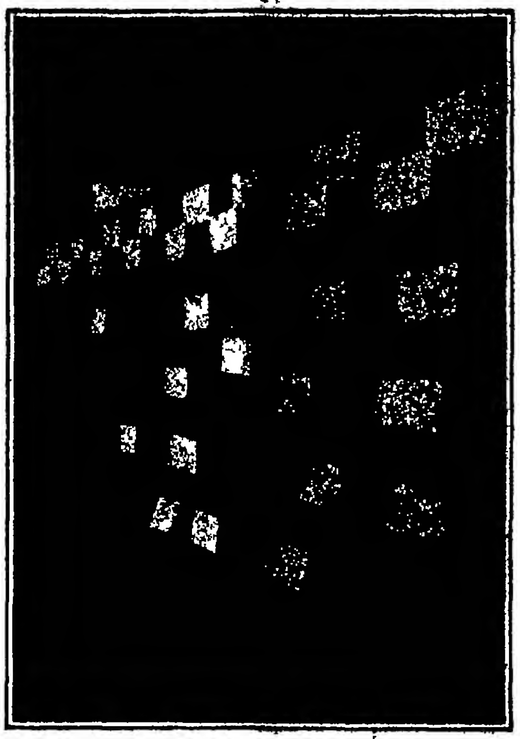
Usually several sheets of each grade are used for the test, so that when the results are obtained, such results will be averages and not single instances. Flat sheets can be used, but in order to stiffen the sheets it is customary to corrugate all specimens uniformly.

The sheets are securely nailed to a wooden rack which has been erected in an open space in such a manner that the entire test will be equally exposed.

After the sheets are in readiness and the rack prepared, all sheets should be nailed in place at the same time. It would not be satisfactory to place one grade on the rack and then wait a few days to place the remainder. The angle at which sheets are exposed varies from 15 to 90 degrees. In choosing an angle it must be remembered that the less the angle the more severe are the service conditions. After choosing the angle, all sheets must be exposed with the same degree of slope.

In deciding on the locality in which to conduct the test, several points must be considered. If the test is started in a congested manufacturing district where the sheets are exposed to air laden with smoke the atmosphere will be contaminated by the products of combustion and will be an "acid atmosphere." Such was the air condition surrounding the Pittsburgh tests as conducted by the American Society for Testing Materials. In such atmospheres the conditions of service are far from normal, and so unusually severe that all grades of material will fail comparatively early. Such acid conditions are further indicated by the fact that incrustations of ferrous sulfate will appear on the sheets after exposure.

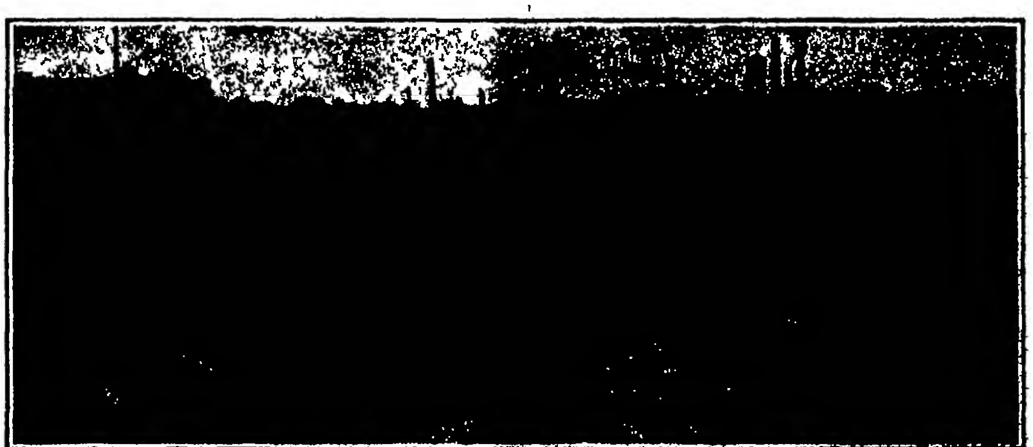
In a rural community where the air is pure the entire test will run several years before failures are obtained. Also, in sea air, where test conditions are again entirely different, the service life of the sheets under test will not be comparable with results obtained in "acid atmospheres" or in air free from active reagents.



A large number of samples undergoing immersion tests for corrosion

With reference to the coating protection to be applied to the commercial sheets chosen for atmospheric tests, galvanizing is recommended. Bare, uncoated sheets were used for the Pittsburgh test as above mentioned. This was unfortunate in that the results obtained have so limited an application. The number of actual service installations where bare, uncoated sheets are used is trivial. Since tests should simulate actual service conditions as near as possible, the choice of coated sheets for atmospheric tests is most desirable.

To insure uniformity of conditions in immersion test investigations all variables in any way relevant must be considered. The following are important.



Atmospheric corrosion tests of metal sheets

All test specimens must be uniform in gage and size. Samples 16-gage, 2 x 2 inches, are recommended as convenient gage and size, although other measurements will answer quite as well, provided uniformity is maintained.

All samples must be free from grease, oil, rust, dirt, scale, mechanical injuries, surface irregularities, excessively deep stencil marks, etc. To remove scale all specimens should be uniformly pickled in concentrated hydrochloric acid, washed well, and dried.

Temperature conditions must remain constant. The samples should be carefully weighed, vertically placed in separate tumblers and completely immersed in equal solution volumes, say, 800 cc. for each specimen. The entire test should be started at the same time. Any tendency toward unequal evaporation of the corroding liquid must be eliminated. All experiments must be conducted at least in duplicate (triplicate is even better), and weight losses of each grade should agree closely.

Great care must be exercised to guard against exhaustion of solution strength caused by the nature of the chemical reaction. It is necessary to remove the test pieces at proper time intervals and replace same in equal volumes of freshly prepared corroding media.

When it is desirable to discontinue the test all specimens must be removed from the solution at the same time, washed well in running water, scraped free from adhering particles, dried and weighed. The corrosion losses are usually reported as loss in grams per square meter, or ounces per square foot of actual surface exposed.

The investigator has an unlimited field from which to choose the corroding medium. By way of example, solutions of the following chemicals might be mentioned.

Ammonium nitrate, acetic acid (vinegar), hydrochloric acid, ammonium persulfate, sulfuric acid, aluminum sulfate, and acidulated ferrous sulfate. Among the many examples where ferrous metal installations are subjected to such immersion conditions might be mentioned the dyeing industry, paper making, coal-mine equipment, manufacture and use of vinegar, chemical plants, sewage-disposal systems, various acidulated waters, water-purification plants, etc.

The desirable strength of a given corrosive solution, and the best period of solution change, vary for different solutions. Aluminum nitrate should be in a 3 per cent solution and should be changed every three days. For other solutions the corresponding figures are: acetic acid, 3 per cent and 5 days, hydrochloric acid, 38 per cent and ½ hour or 20 per cent and 2 hours, ammonium persulfate, 10 per cent and 24 hours, sulfuric acid, 5 per cent and 48 hours, aluminum sulfate, 20 per cent and 4 days, ferrous sulfate acidulated with 0.7 per cent sulfuric acid, 1 per cent and 24 hours.

Immersion tests yield very valuable data when scientifically conducted as here outlined. The test-variables as enumerated are essential. To neglect any condition of uniformity means that misleading results are obtained. Yet they are not so technical but that a careful investigator who is desirous of obtaining true results can easily follow them to a successful and reliable conclusion. It is obvious that the big danger of immersion test investigations lies in the fact that carelessness or lack of definite knowledge results in test interpretation of a nonconclusive or contradictory character.

When immersion tests results are published, a full report of testing details should accompany such reports in order to insure the knowing reader that all immersion variables have been considered.

An interesting factor in immersion test investigation is the increasing use of the single solution-volume. A large tank contains all the samples under test and is so constructed that the samples hang on a glass rod without touching each other. The corroding solution can be agitated, aerated, drawn off, changed, analyzed, etc.

Changes of Temperature Curl Concrete Roads

IT has been recently found, in the course of experiments by the U. S. Bureau of Public Roads, that the edges of concrete roads curl up and down in response to changes in temperature. The unequal expansion and contraction of the upper and lower sides of the concrete slab under the influence of heat cause this curling. At the time of day when the surface of the road becomes the hottest it expands more than the cooler under side and the sides move downward. At night, when the edges cool, they curl upward.

The "Rain-Drop" Auto

By [illegible] A. [illegible]

A NOVEL feature of the automobile show recently held in Berlin was the automobile illustrated herewith, which is in some respects a reversion to first principles of the "horseless carriage" type, while in others it embodies the latest aerodynamic data. The machine, which has been christened the "Rain-drop" auto by its designer and builder—Herr Rumpler, the well-known airplane constructor—has a minimum air resistance and is propelled by a motor of small horsepower compared to the size and type of car it propels.

The leading points about this new auto are given herewith. To begin with, the car as a whole is shaped like a rain-drop, which assumes a perfect streamline form—the shape of least resistance. This form has been carried out from the ground up. The chassis has it, as well as the body itself. This shape results in the elimination of much discomfort that is suffered by the passengers of the usual type of automobile, such as noise, heat and smell from the motor and of dust arising from the road.

The chassis is constructed of two wide pieces of pressed steel bowed like the hull of a boat. The front axle passes through the frame without touching it, and flexible springs connect the two. The unsprung masses, which produce swaying, are reduced to a minimum, while the spring-supported masses that stop it form the maximum weight. The result is that the body sways but slightly, while the wheels cling to the ground and bounce but little. Consequently there is very little wear on the tires and the car is extremely steady-riding. Since the main weights are located in one spot, the car, when turned out of its course, regains the road again quickly without tipping. The springs are very flexible. A theoretically perfect suspension is provided, while the placing of the seats between the axles minimizes by one-half the motion imparted by road shocks to these. The chauffeur's seat is in front, in the middle, just back of the front axle. He has a clear view of the road and can run the car much better than when he sits a considerable distance back from the front end as is usual. The variable weight—the passengers—being placed in the middle does not affect in the least the relative load of the front and rear axles, while the constant weight is located at the two ends, the chauffeur being in front and the motor block behind. These weights are always there when the car is running, and they keep the load constant upon the two axles. With the ordinary car the motor and transmission, as well as the chauffeur, are both in front, and thus the rear axle is but lightly loaded, while with this new car the loading of the front and rear axles is practically the same. As the driving and steering wheels are properly loaded, skidding is impossible in wet weather, while with the old style car this is a serious defect.

The motor, transmission, and rear axle form a unit which swings about the rear axle somewhat to allow for road shocks, etc. The number of parts is the lowest possible, great simplicity being obtained, and the length of the motor block being kept very short. The motor is a 6-cylinder, water-cooled one of the Y type, with a third pair of cylinders vertical in the middle of the Y.

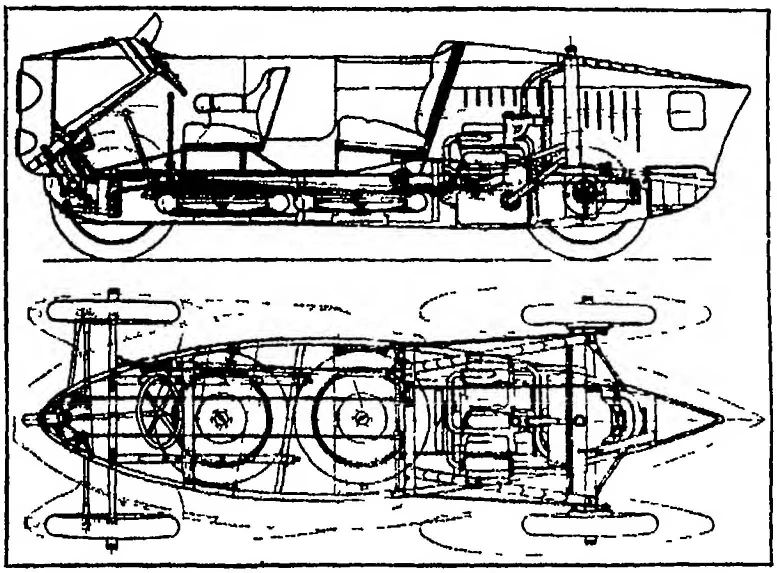
The center of gravity is about 70 mm (2¾ inches) lower than with much heavier cars of ordinary construction, whereby the stability is increased very greatly and curves may be taken without danger at high speed.

Mechanically this new Rumpler automobile is very good indeed. It has no belts, chains or universal joints, yet in spite of all this the rear axle is spring-supported. Its impulse and acceleration at starting and the brake moment in stopping, as well as the "set" of the wheels, are all technically correct. The front wheels do not hit the frame and wear the tires in making sharp turns, and wherever there is rubbing friction, proper lubrication is provided. The front axle is mounted independent of the frame and passes through it without touching it.

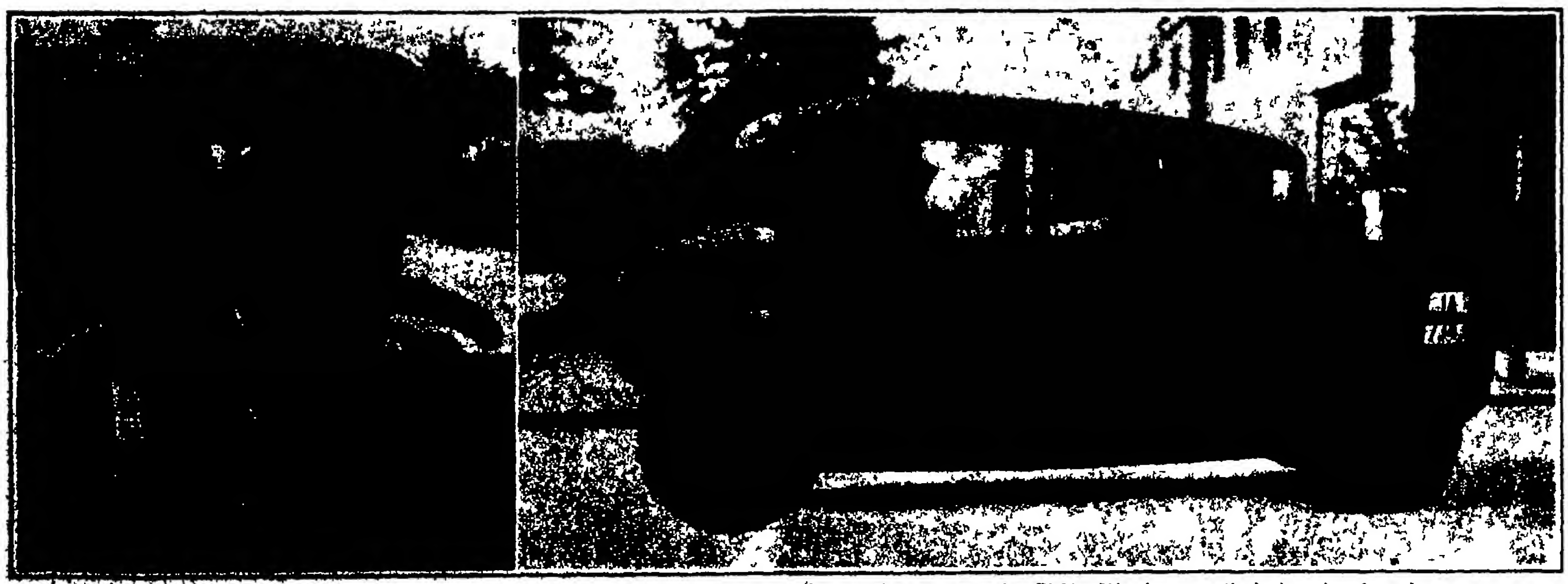
The air resistance of both body and chassis is reduced to a minimum by streamlining to the shape of a drop of water falling. This drop form is strongly maintained both with open as well as with closed cars. The roof of the limousine has the form of an airplane wing, or aerofoil, in profile whereby air resistance at high speed is reduced. A comparison of the Rumpler with the old style cars as to cross-section shows the former to have but a fraction of the air resistance of the latter. The outside is completely smooth; the mud guards are rudimentary airplane wings; the lamps and spare rim brackets do not project, but are built into the body itself. The spare wheels are neither on the side nor behind the car body, but are concealed in the chassis. The front springs as well as the rear ones are fully built in with the exception of the rear ends of the latter. Merely the ends of the axles project beyond the chassis frame and make air resistance. The exhaust is ingeniously concealed at the extreme rear end of the car. The clutch pedal and brake lever are inside the body, while the running boards can be folded up when the car is under way.

Due to its careful streamlining the air penetration is unsurpassed and the dust question has been solved completely both for open and closed cars. Passengers riding in the latter will have plenty of fresh air and will no longer be annoyed by gas fumes, heat, and noise, for the air stream is drawn back by the radiator fan of the rearwardly-located motor. The oil consumption is reduced to a minimum, and special provision is made to assure no leakage.

Chassis with unit power-plant and swinging rear-axle



Sectional view and plan of Germany's latest automobile production



Left: Front view showing the superimposed headlights and the sidelights mounted on the ends of flat mud-guards. Right: Side view; note the horizontal mud-guards

Two aspects of the all-streamline limousine

Potash, An Essential for Plant Growth

The Wide Scattering and Low Concentration of America's Deposits, and What We Can Do About It

By George H. Dacy

Dryers in a California plant where potash is extracted from kelp

THE greatest phosphate deposits in the world occur in the United States and are made much of whereas our potash holdings, which are more than twenty times as large, are little used because they are spread over such an extensive area and because the deposits are of low concentration, none of them averaging much over 10 per cent Most of the combinations in which potash occurs in the natural state are neither soluble in water nor in acid—circumstances which render their profitable salvage for commercial uses almost impossible The chief source of all potash salts is a class of igneous rocks known as the feldspar group Weathering and exposure leach the potash from these safety deposit vaults and lay it down in the soil, in the ocean or in inland depressions. Subsequently, when the water into which this potash has been carried evaporates, soluble deposits are formed The potash liberated from disintegrated rock is taken up and stored in plants and may be recovered by burning the plant Hence there are three natural sources of potash—rocks, salty lakes or soluble deposits and plant materials

Every plant needs potash if it is to make healthy and vigorous growth and profitable crop yields are possible only where the green, growing plants have access to plenty of this food. Potash starvation is evidenced when the leaves of the plant become brown and unhealthy looking and the stems become weak and brittle Plenty of potash enables a plant better to resist the attacks of fungous diseases, it produces fleshy fruits of fine flavor and texture and it provides sustenance essential to normal growth and development A problem which has long been of particular concern to the national Department of Agriculture has been the matter of making the most of our natural potash supplies. The government experts have investigated and experimented with this and that method of reclamation and salvage and have built the foundation for what potentially promises to develop into a national industry which to a certain extent, if properly handled, may be able to compete with the imported potash from France and Germany

Potash salts obtained from the brine of Searles Lake, Cal.

Attempts have been made to use the mineral rocks rich in potash directly as fertilizers, but the results have not been favorable the expenses of application being out of ratio with the benefits obtained from such practices. The practical plan perfected has featured the treatment of the material with acids or in other ways to render the potash soluble before using it for fertilizing purposes. The fact that most of the minerals and rocks are very low in potash content has complicated this problem as, although successful methods of extracting and rendering soluble the potash were devised, the value of the fertilizer freed did not justify the expenses of these operations. Up to this time unfortunately no mine-run rock has been discovered in the United States which contains as high a percentage of potash as the deposits of Germany and France in which the potash is already soluble The most satisfactory results have obtained from recovering potash as a by product from some of the industries where potash rich rocks are used as raw materials.

The Federal Bureau of Soils reports, "A study was made of potash recovery from rocks which showed that the most practical results occurred where silicate rock was ignited with lime as in the manufacture of cement, or by the digestion of the rock with lime and water under pressure. In the first process potash is volatilized and passes from the kilns in the process of burning, being collected on electrical precipitators, while in the second it passes into solution during the digestion In both cases the residue is suited for the manufacture of cement or other building material At the present time both of these methods evolved by the government soil chemists are being developed on a commercial scale"

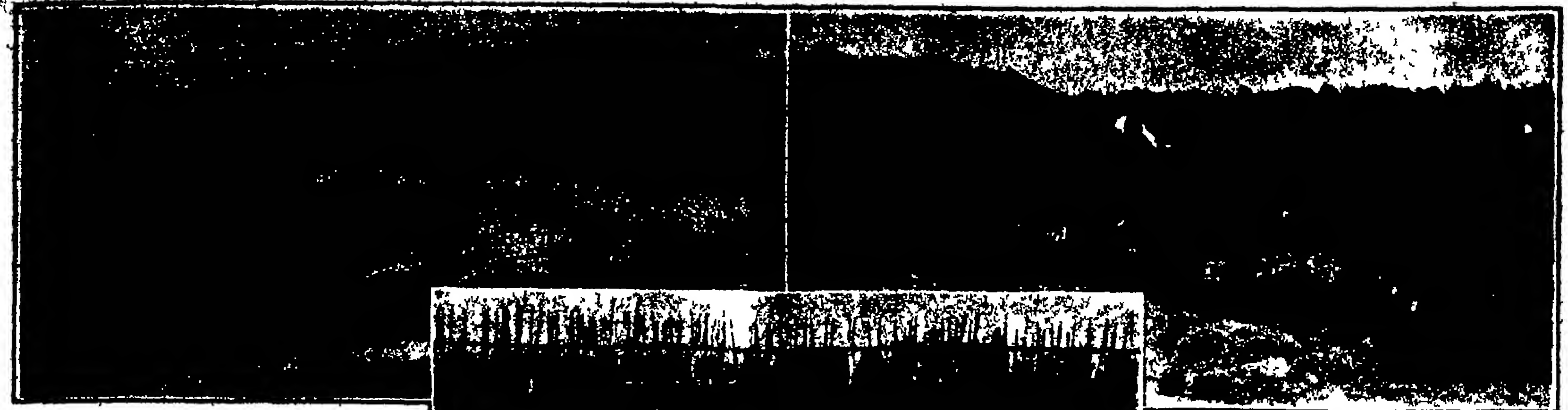
"The process of digesting the potash silicates with lime and steam under pressure has occupied our attention and research activities for some time," said Mr. W H. Ross of the Bureau of Soils when the writer interviewed him recently "and it has been found possible with pressure such as can readily be maintained in the industries to accomplish a very high percentage extraction of potash. This process is now being developed on an elaborate scale for the treatment of greensands—certain soils occurring along the Atlantic Coast from Delaware and New Jersey on south to the Carolinas, which are rich in potash—with the object of producing bricks and other building material in addition to potash As a market is found for such building materials, this doubtless will prove a profitable but limited source of potash"

The domestic cement plants in this country produce approximately 86,000,000 barrels of cement annually, with an average loss of about 87,000 tons of potash which was carried away in the fumes previous to the inception of an efficient method of conserving these waste gases. The largest amount of potash recovered in this way since the perfection of this salvage system has been 1621 tons, which that year was 5 per cent of the total supply produced in this country. The trouble has been that the potash volatilized from some plants was too small in amount to save, while in other instances so much dust was collected with the potash that it did not pay to leach the material nor to ship it for direct use as a fertilizer. It is anticipated that shortly either a mechanical method of separating the potash and dust during collection will be devised or a system of reducing the amount of dust which can escape from the cement plants will be perfected.

Potash can also be recovered from blast furnaces as it is volatilized as an impurity from ore, coke and limestone used in the charges. The Bureau of Soils is now investigating such sources of potash recovery and has already ascertained that the percentage of potash in the dust that escapes from some blast furnaces is much higher than that contained in the richest cement dust. However, the practice at most blast furnaces is to purify the gases by the use of a wet purification system which causes the potash fumes to be lost so far as commercial recovery is concerned. The federal authorities are now striving to perfect a dry purification method which will permit of the saving of this potash as they have demonstrated that such a system would feature the conservation of potash at a low cost.

The world's largest potash deposits in Germany and Alsace were formed by the shutting off of an arm of the

Retort furnace used in getting the potash out of the sea-weed



1. General view, showing terraced vineyard on sand dunes. 2. In the foreground the low fence on the earth side above, the higher one toward the sea 3 A close-up of the vines

The vineyard by the sea

sea by a peculiar bar of land which acted like a trap permitting the sea water to flow into the bay at high tide, but, subsequently, not allowing these waters to recede as the tide ebbed. As these waters evaporated, soluble deposits of potash and other salts were built up, and, finally, when the bay was permanently land locked, a large area of salts in some places 5000 feet deep had been stored away Small deposits in western Nebraska, California and Utah have resulted in this country from the evaporation of fresh lake water

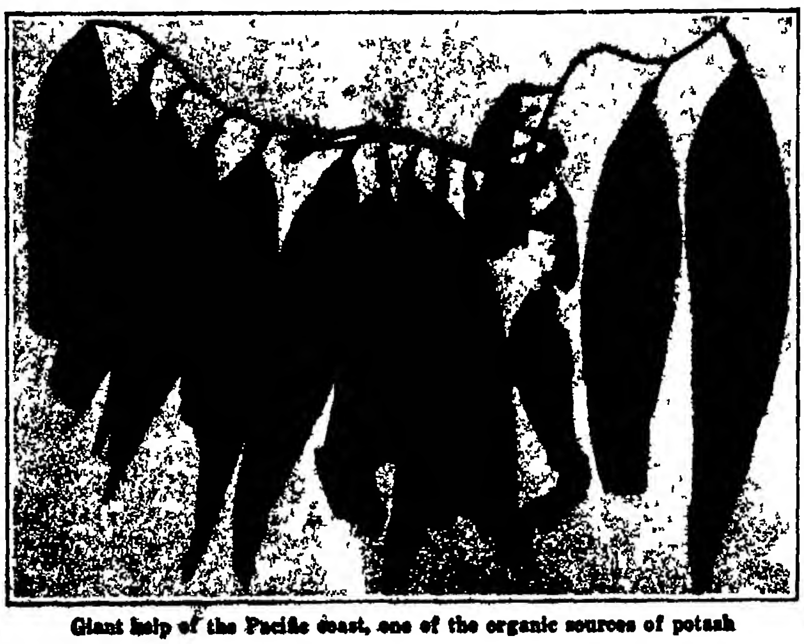
"The lakes from which these deposits have been formed have not been evaporated completely, but have simply been reduced to a potash-bearing brine which in some instances contains as much as 25 per cent of potash," remarked Mr Ross during our conversation. "This potash is recovered by pumping the brine from the lakes, concentrating it in special evaporators and finally drying the chemical in rotary kilns. During a recent five-year period, the recovery of potash from these lakes represented 48 per cent of our total domestic production, and the future of the industry will depend principally on government experiments now under way to improve these methods of extraction. It is hoped that solar radiation may be harnessed for concentrating the brine, this would markedly reduce the expenses. This is possible as the concentration of the brine as it occurs in the lakes is greatest during the dry season."

"The deposit at Searles Lake, California," continued Mr. Ross, "is the largest natural storage of soluble potash salts in the United States. The salts in the brine of this lake contain considerable amounts of soluble borax which is injurious to crops. Hence it is necessary to eliminate this material from the potash by the crystallization of the recovered salt. This method has been perfected to the extent that the potash as prepared for use in fertilizers contains less than 0.5 per cent of borax, an amount which is not injurious to plant growth."

Sugar beets, wood, wool, kelp and tobacco are all rich in potash, but none of these materials except kelp is treated primarily for the recovery of potash, although their wastes are utilized in this manner Frequently, these wastes are distributed over such a large territory that it is impractical to attempt to recover the potash. For example, the total amount of potash in the ash of wood burned as waste and that used for fuel amounts to more than 140,000 tons annually—which is about 56 per cent of the amount of potash which we customarily import during normal times. The great majority of this potash emanating from wood ashes is lost so far as economic use for fertilizer purposes is concerned.

A heavy expense is involved in evaporating the large volume of water from kelp and sugar residues. The total potash in the average annual sugar-beet crop amounts to approximately 20,000 tons. During manufacture, this potash remains in solution and a certain part of it is found in the final molasses, a goodly portion of which is fed to live stock and ultimately recovered for fertilizer in the resultant manure A second portion is used in alcohol production, the still residues being concentrated and used as potash fertilizers. The remaining portion, about one-half of the total, is subjected to a special precipitation process which abstracts the residue sugar remaining in the molasses. Potash occurs in the waste water from this process and is recovered by evaporation However, unless these waste waters are found to yield other valuable products besides potash, it is doubtful if ever much more than 4000 tons of potash a year will be salvaged in this manner

The extraction of potash from kelp was rendered practical during the war only as a result of the scarcity of potash, the commercial treatment is too costly to be practical under normal conditions. At present, the Bureau of Soils is experimenting to determine a practical method of saving potash from kelp which can be practiced during normal times. Uncle Sam reports that by subjecting dried kelp to destructive distillation, there can be volatilized such products as ammonia, oils, creosote and pitch in such a manner that potash salts, active carbon and iodine may be recovered from the residue The results show that these other products will yield sufficient revenue to enable the recovered potash salts to be marketed successfully in competition with potash of foreign origin.



Giant kelp of the Pacific coast, one of the organic sources of potash

A Seaside Vineyard

THE grape finds, in latitudes widely scattered, the conditions necessary for its development It is only necessary that it receive in abundant profusion the light and the vivifying heat of the sun Nevertheless it is something of a shock to find vineyards along the Atlantic coast of France, down at the foothills of the Pyrenees and within a mile or two of the sea. Vineyards, to be sure, are found at various points along the dunes of the Mediterranean shore, but their situation is ordinarily such as to protect them against too abundant rains and heavy winds.

At the Anglet vineyards illustrated herewith, the young vines are protected merely by palisades of tamarisk branches which surround them on all sides. Stakes driven into the sand from point to point keep these barricades firm while rows of poles, disposed horizontally, contribute still further to stability in the face of the north wind which is in this region the prevalent one of winter

The sight of a prosperous vineyard so close to the ocean goes to prove that the vine, just so it has sufficient heat from the sun to bring it to normal ripeness, will accommodate itself to pretty much any sort of soil. But who would have supposed that on the shores of the Bay of Biscay, where the waves beat up with such terrific force, one would ever see a plantation of vigorous grape vines?

Yet the proprietor of this establishment does not give to his vines any more extraordinary care than his contemporaries in more usual situations. He prunes them, he supplies them with props, he keeps them well hoed and weeded, and this half-century they have been bearing, each year, an abundant crop of black and white grapes.

Finally, even more curious, this original Pyreneean vineyard furnishes in addition most excellent table raisins for after intelligent and patient observations, its proprietor has found how to bring about the variations appropriate to the particular climatic conditions and to the physical nature of this sandy soil He has sacrificed quantity for quality, and if the bottles of old Anglet in his cellar are not as numerous as those of other vintages, their contents possess no less a delicate bouquet. Needless to say in view of its long record, he has been able to make a complete commercial success of this extraordinarily situated grape farm.—*By Jacques Boyer*

Better Use of Low-Grade Coal

A Coking Furnace of Novel Design Which Greatly Enlarges the Bounds of the Steel Industry

By George H. Dacy

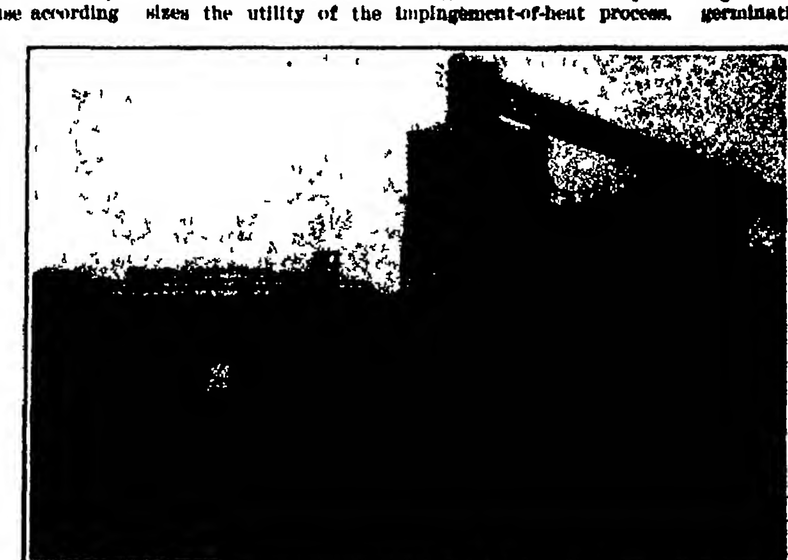
AMONG recent inventions is that of Arthur Roberts, an Illinois engineer—a new oven which admits of coking non-coking types of coal that heretofore have not been available for such disposition. Hitherto the vast fields of Illinois and Indiana coals have been useful only for steaming purposes and have sold for anywhere from $10 to $25 an acre, as compared with prices of $1500 to $3500 an acre for special-purpose coking coals. The inception and perfection of the new coke oven vastly increases our coking-coal resources. Heretofore, only three per cent of our coal supply has been adapted for coking. These valuable deposits have been centralized in the congested sections of the Virginias, Pennsylvania, Kentucky and Alabama, and steel manufacturing industries have been promoted in those neighborhoods proximate to the supply sources of coking coals.

At one middle western coke plant, a total of 80 of the new coke ovens has been installed, consisting of two batteries of 40 ovens each which discharge their finished product at alternate intervals. These ovens handle 1200 tons of coal at a charging and in a period of 14 hours convert it into high grade coke and its by-products. The novel coke oven is of the narrow type and flueless. It has been tested out officially and approved by the United States Bureau of Standards. As a result of its use, Illinois coal yields 72 per cent by weight of a satisfactory smelting coke, and produces such by-products as 3.5 to 4 gallons of light oils, 10 gallons of tar, 30 pounds of ammonia sulfate and an average of 11,000 cubic feet of gas per ton of coal.

Sectional view of top of the battery of ovens, showing extension mains from ovens to hydraulic mains, crossover pipe which carries gas to the by-product apparatus, and elevated rail on the backstays on which the car runs

Illinois coal is now yielding a quality of metallurgical coke which is producing the highest grades of iron used in the industries on fewer pounds of coke per ton of metal than has been possible in the past, even where the very best grades of coking coal were employed. The new coke ovens facilitate the salvaging of all the valuable by-products even more efficiently than by the methods and appliances used in European countries where the long coking period is universally practiced. In Europe the greatest efficiency is not realized from the coking oven, because according to overseas methods it takes from 30 to 36 hours to coke an oven of coal, whereas in this country the processes are expedited as much as possible, the usual coking period ranging from 17.5 to 19 hours.

The American system of rapid coking has featured the operation of the coke ovens at very high temperatures, with the result that the ovens deteriorate rapidly while many of the hydrocarbons are cracked so that inferior by-products are produced. The new coke oven recently invented corrects all these previous defects, being operated at a low temperature which permits of saving uninjured the hydrocarbons and by-products. This oven not only makes a fine grade of coke from the non-coking varieties of coal, but it also produces a finer quality of coke from the specialized coking coals than ever previously has been obtained. These ovens are more durable and efficient, while their operating expenses are much lower than those of the old style. The new types of coke ovens are the largest and strongest that were ever built, while they feature the outstanding advantage that every operation center is of easy access and not remotely situated away down in the hot temperature zones as is the case in many of the old-fashioned ovens now in use.



Battery of 40 of new type by-product coke ovens. The car, which carries 15 tons of coal, is shown suspended on the rails over the top of the ovens

This modern oven is a scientific machine built to create economically and efficiently in a flexible way the conditions required for the coking of coal. It is extremely flexible in producing and applying the agency required to coke the coal, and permits of changing the conditions to comply with the requirements of every type or variety of coal. It cokes a larger quantity of coal per oven per given unit of time than any other oven ever built and it performs this work at a much lower temperature than is possible in any other coke ovens. It produces a better quality of by-products than other ovens because it utilizes only the required heat of distillation in proper volume, and does not have to depend on abnormally high heats essential in other ovens in order that a sufficient capacity of coal per oven per day may be developed.

Unlike other coke ovens, the Roberts oven is so elastic that it will handle any kind of coal without costly alterations. The tendency of all coke producers was to utilize the wider types of ovens, until Mr. Roberts began his early experiments which have been extended over a period of 12 years and which have been responsible for the production and perfection of the new Roberts oven. His researches demonstrated conclusively that the narrow types of coke ovens are more efficient and now ovens of this variety are universally popular. All other ovens employ the skin-friction process of heat utilization while the Roberts' oven emphasizes the utility of the impingement-of-heat process. Each individual part of this new type of oven is designed to perform in the most economical and efficient manner its special function without saddling any extra burdens on the other parts. This feature has been more or less neglected in other coke ovens.

The invention of a coke oven which will coke non-coking varieties of coal vastly expands the operations of the American steel industry, which previously has been restricted in development to those sections close to the supply sources of coking coal. It permits of the potential development of steel production on a large scale in cities of the Corn Belt states. The Mississippi River provides cheap water transportation for the transfer of the ore from the northern ranges to cities located along that mighty stream. Non-coking coals can now be used to produce coke for converting the ore into steel. Take, for example, the case of St. Louis. The middle western and southwestern steel markets served advantageously from St. Louis as a center consume more than 10,000,000 tons of steel annually. The use of the new coke ovens will promote the potential production of a majority of this steel close to the localities where it will be used.

Germination of Light-Sensitive Seeds

THE *Botanical Gazette* for April contains an important article by Wright A. Gardner on the effect of light on germination of light-sensitive seeds. In his investigations Mr. Gardner attempts to discover the fundamental relation of light to the germination of seeds, and to show just what light does to start germination. The seeds of about 15 different species and varieties were used. The author presents his results in tabular form and concludes:

The seeds of *Rumex crispus*, *Datura Stramonium*, and *Phoradendron flavescens* were found to be light sensitive. The germination of seeds of *Rumex crispus* and *Phoradendron flavescens* was promoted by light, the germination of seeds of *Datura Stramonium* was hindered by light.

Abrasion and removal of coats (ovary walls) of *Rumex crispus* seeds promoted their germination in darkness.

Treatment of seeds of *Rumex crispus* and *Oenothera biennis* with concentrated sulfuric acid caused an increase in the percentage of germination in darkness.

No reciprocal relation between the effects of light and temperature was found. Light was not necessary for the absorption of sufficient water for germination. Injection of water did not yield increased germination in darkness. Almost all kinds of single electrolytes, regardless of the nature of the ions, seemed to promote germination of seeds of *Oenothera biennis*, *Nicotiana Tabacum*, and *Verbascum Thapsus* in darkness. Embryos of seeds incubated in light became more acid than those incubated in darkness. Light seemed to activate lipolytic enzymes which hydrolysed fats to fatty acids.

The germination of seeds of *Rumex crispus* in darkness was promoted (increased) by hot water treatment, abrasion, treatment with concentrated sulfuric acid, sodium sulphocyanate, and hydrogen peroxide.

The germination of seeds of *Nicotiana Tabacum* in darkness was promoted by soaking in solutions of hydrochloric acid, sodium sulphocyanate, and hydrogen peroxide, as well as by the use of many single electrolytes as substrata.

The germination of seeds of *Verbascum Thapsus* in darkness was promoted by the action of light, fluctuation of temperature during incubation, alternating high and low temperatures, soil, and many single electrolytes as substrata.

The germination of seeds of *Oenothera biennis* in darkness was promoted during certain seasons by hot water treatment, sulfuric acid, preliminary incubation at low temperature, incubation in alternating high and low temperatures, and single electrolytes as substrata.

The germination of seeds of *Daucus Carota* in darkness was promoted by increased oxygen pressure and preliminary incubation at low temperatures, while it was hindered by soaking in hydrochloric acid and by the use of single electrolytes as substrata.

It appears that, while these experiments are not complete enough, as regards either species or conditions, for final conclusions, it would be safe to say that the treatments used, in general, promote germination.

Taking the Fire Hazard Out of the Oil Tank

THE immense losses due to fire caused by the contents of large oil or gasoline tanks igniting, have been made impossible by the construction of a new type of oil tank, or rather an oil-tank cover, which absolutely protects the contents of a big container from conflagration, even though fire be built on its very top. Heretofore, efforts to protect stored oil and gasoline have been confined chiefly to making the stationary roofs of the tanks air tight and closely joined to the vertical walls. The new principle used in this recently devised protector is that of a floating roof which rides upon the surface of the oil regardless of its level and so at all times prevents its exposure to the air. In this way the roof is of value in preventing evaporation, as well as in preventing fires.

In order that the roof may ride easily on the oil and rise and fall with the changing level, the diameter of a given roof is several inches less than the diameter of the tank. For a 50-foot tank the roof diameter would be 48 feet. The remaining space between edge of the roof and tank wall is filled by ingenious gravel-filled buffers, which provide a sort of cushion that easily rides over any irregularities in the tank wall. These gravel carriers are built of 10 or 12 gage metal and are each hinged to the roof and held in place by means of a spring.

For the purpose of demonstrating the absolute protection afforded by this invention the makers have frequently piled brush on the top of one of these roofs and then after saturating it with oil have set it afire. Despite the intense heat of such a test, the oil below has never caught fire, even the edges being thoroughly shut off from air by the gravel-filled buffers.

On the roof of the new oil tank, which rises and falls like a gas tank

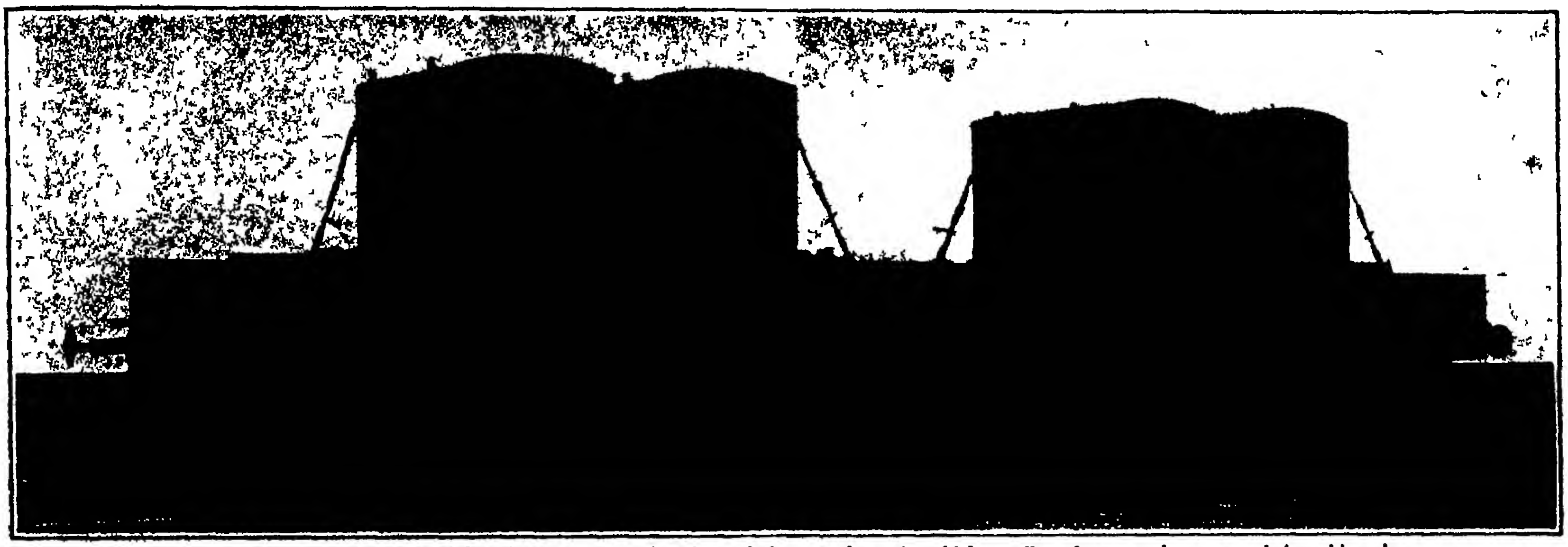
Container System in Operation on British Railways

WE recently illustrated a system of container cars which is in operation on the lines of the New York Central Railroad, and the accompanying photographs, for which we are indebted to the courtesy of the *Railway Review*, show the containers used for freight and mail service between London and Belfast, by way of the London and Northwestern Railways. The containers have been built with the following dimensions: length outside, 6 feet 11 inches, width outside, 4 feet 8 inches, height, including wheels, 7 feet 1½ inches; and the capacity of each container is 154 cubic feet. They were designed for the rapid transit shipment of parcels and baggage between train and boat at the Fleetwood docks, from which the Belfast steamers sail, and between the boat and quay at Belfast. They are carried on 45-foot flat cars, accommodating four containers each. The framing of the containers is on the outside, and they are finished with flush walls and varnished on the inside, so that there are no projections to damage the contents. At each end of the containers is a door through which, when on the truck they can be loaded or unloaded from either side of the train.

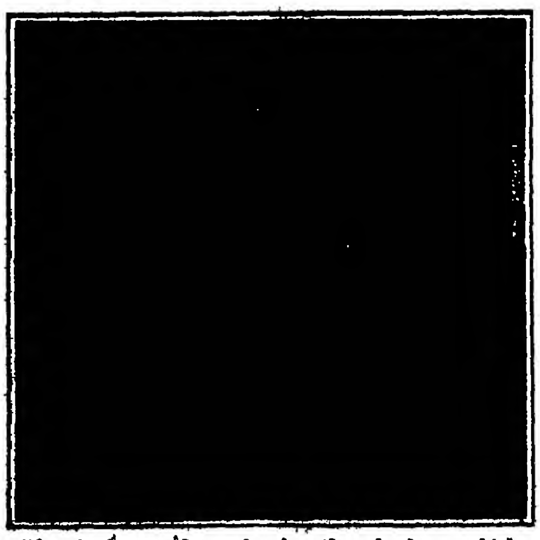
Two steel lifting slings are fixed around the bottom and sides of each container and terminate at the top in eyes for the chain hooks of the lifting cranes. Each container is carried on six broad-faced wheels, the center pair being slightly larger than the two outer pairs, so as to make it easy to handle the containers on the quay side.

Each container is secured on the car by four chains which are hooked to the eyes of the lifting slings and lead down to the sides of the car, the slack being taken up by screw shackles. Steel channel bars adjusted across the top of the car sides assist in keeping the containers in place.

According to our contemporary, the containers have proved very satisfactory. Delay in transit is obviated, and since the freight travels under seal from the sender to the receiver, the risk of theft is eliminated. Their use does away with four distinct handlings, and this, of course, reduces the liability to damage, the goods being carefully and closely packed. This result is shown by the marked reduction in complaints and claims which has been noted since the containers were put in service.



Flat car on the London and Northwestern, carrying four of the containers in which small package goods are now being shipped



The single container, showing the wheels on which it is mounted

New Kind of Pipe Made of Fiber

A NEW kind of pipe has been put on the market which, it is believed, will solve many troubles now encountered in steel and other straight-line pipe. It is claimed that sulfuric, hydrochloric, acetic and other acids do not injure it and that chlorine gas will not harm it.

Its strength, unlike that of wood pipe, is not dependent on iron bands, but is inherent in the pipe itself, says an authority. A little paint scratched off wood-stave pipe and the bands will corrode, leaving it no longer watertight. The joints of this pipe are, moreover, screwed and therefore reliable.

As for weight, however, it is one-quarter that of iron or steel pipe; as for strength it has stood 4124 pounds per square inch of cross-sectional area applied externally, and 752 pounds applied internally. It is recommended by the manufacturers for use under a pressure not exceeding 600 pounds per square inch, as they assert that it is capable of withstanding much greater pressures under actual working conditions.

The Massachusetts Institute of Technology has shown that it expands only twenty-six ten-millionths of an inch per degree Fahrenheit. Sudden changes of temperature do not affect it, but it is not recommended for use in conveying steam or hot water at over 180 deg. F. Being light, 25,000 ft. or more of 3-in. pipe can be carried in a single carload. Two-inch pipe weighs 1½ lbs. per ft.; 2½-in. pipe, 2 lbs.; 3-in. pipe, 2.5 lbs.; 4-in. pipe, 4.5 lbs., and 6-in., 7 lbs. The threads are well formed and can be made with hand threading machines furnished by the manufacturer. Even 6-in. pipe can be threaded by hand.

It is at present made in only 7-ft. lengths or shorter, and it can not be provided with fittings of like material. Lead-lined iron ells and tees are furnished to go with the pipe, also combination couplings for connecting it with iron pipe and pumps. The fiber pipe can be leaded into cast-iron fittings. The cost is unexpectedly low, and it can be installed for half as much as metal pipe, because it is light and easy to handle. A coating of a specially-prepared paint makes the joints airtight. No tools are needed to lay it.

Iron Corrosion by Carbon Dioxide

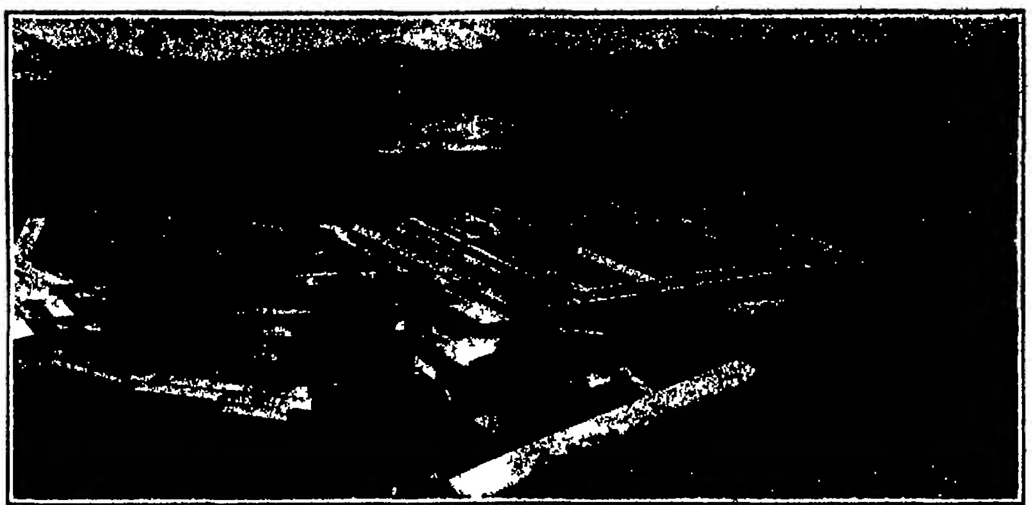
AN instance in which the corrosion of iron pipes was directly traceable to the presence of carbon dioxide in steam is reported by a writer in a German chemical paper. The wrought iron pipes carrying away the condensed water from the steam radiators employed to heat the air in a large drying plant were found to suffer greatly from internal corrosion, so that they had to be renewed about every six weeks. Investigation led to the conclusion that the cause must be sought in the steam or rather, in agents accompanying the steam, the most probable being carbon dioxide in considerable amount. On pursuing the matter further it was found that the water-softening plant for the boilers was not up to its work, and allowed a large proportion of calcium carbonate to pass into the boilers, where it decomposed, the whole of the liberated carbon dioxide accompanying the steam through the heating system.

Building Better Homes

Factory-Made Houses that Nevertheless Mark a Return to the Ways of Our Grandfathers

By A. H. Scott

THROUGHOUT New England there are standing today many farmhouses and town residences of from seventy five to two hundred years old which are still as habitable as when originally built. These old houses were built when materials and labor were comparatively cheap and the lumber and hardware employed in their construction were first class and the work done painstaking and fine. In former days of hand work artisans took great pride in fitting even the minute and unseen parts so carefully that no structural weakness would develop to mar their work as time went on and the building was subjected to rigorous climatic changes. On the other hand, we have today the average house put up by the speculative builder which in a decade or two will be a shabby looking structure inside and out, particularly if it is a two or three decker which has been rented and not lived in by the owner. If these buildings had been fabricated with care and the same style of framing employed as that used by our ancestors they would not show nearly such rapid deterioration even under the modern rental system.



Frames in position in the order of their erection

At present the nation wide slogan is "Own your own home," and it is a hopeful sign that the drift does seem to be in this direction, as the majority of building permits being issued just now are for the erection of small single houses to be used as homes by men of average means. Such houses are usually built under individual contracts and the progress made watched over day by day by the prospective home owner, who having prospects of spending a considerable part of his life under its roof sees to it, as far as he knows, that no slipshod work or faulty material enters into its construction.

In our forefathers' time when a home was to be built the foundation was made ready and the frame assembled flat upon the ground and when all was ready the homesteaders in the vicinity gathered for the house-raising. The work of raising the framed sections into position and pinning them together was quickly accomplished, and not infrequently the building was completely sheathed in and roofed over by sundown. This framing of the building on the ground in advance necessitated diagonal bracing of the members in order to hold them together while being raised. This diagonal bracing is also the secret of the strength and lasting structural qualities of so many of these fine old homesteads, and unless they have been neglected or uninhabited and thus fallen into actual decay few of these old houses will be found out of plumb or to have developed other structural faults.

The modern method of preparing the wall-supporting structure is termed "balloon framing" the studding being set in a vertical position with no diagonal bracing of any kind, the wall depending for its rigidity merely on the sheathing which is nailed to the outside and to a slight extent upon the lath. This method of framing has led the present generation to become accustomed to seeing unsightly cracks appear in the plaster, floors drawn away from the baseboards and doors that appear to have been made too large for their casings. Such faults are usually ascribed to the inevitable shrinkage of the timber causing the lath to pull from the studding and crack the plaster, etc., which is true enough but it is equally true that a house can be so framed that such flaws can be to a large extent prevented. And substantial and lasting quality at a reasonable price is what is being insisted upon by the man building a home today. How to combine this accomplishment with the ready-cut feature which is necessary if a one-family house is to be maintained within the limits of the average man's credit is a problem which is being solved by adapting the old time rugged brace-framing methods of our forefathers to meet modern requirements. The term "readiframed" has been coined to describe this method of preparing the frame, and it is truly all the name implies. By referring to the cuts it will be observed that the frame is actually made in conveniently handled sections ready for quick assembly in the building. The diagonal bracing is seen to be continuous, holding each stud firmly in place and perfectly rigid, insuring a wall that will not allow the plaster or stucco to crack, and a house that will not sag.

These houses are built on a uniform plan of internal arrangement, but the exterior, such as piazza, doorway and finish, can be so modified that their similarity in this respect is unnoticeable. This allows for all the framing and all other so-called "rough parts" to be cut to fit at the mill, while the fabrication and assembly of the frame proper is a distinct advance over the method of merely numbering the individual pieces and shipping them separately to the builder, who necessarily spends considerable time sorting them over and nailing them together. The lumber is first dressed on all four sides and then cut according to drawing in sets of five, as this is the minimum number of any design which it has been found economical to fabricate at one time. To prepare the material for five houses requires only seventy working hours at the mill, all the sawing for five duplicate houses being done by one man, who has to make but one reference to the drawings for each set of five of any one part. These parts are piled in sets of five and move forward to the assemblers, who nail the framing material together and number the parts thus formed. The diagonal bracing is all cut from material which would ordinarily go to waste if the lumber were hand-sawed on the premises. To take a specific instance, many piazzas are seven feet wide, an odd width which results in much waste of good material. The piazzas of this line of houses are therefore made eight feet wide, the left-over four feet from standard twelve-foot studding being used to make two two-foot diagonal wall braces. Thus a saving is not only made, but strength is added to the building and a more spacious piazza is secured. The diagonal bracing is also used between studding of partitions, where it serves as a "fire stop," a feature demanded wherever building inspection is in force. The sections when completely assembled are made to fit perfectly, and in addition to being numbered are otherwise so marked that no time will be lost in fitting when the house is being erected. The assembled sections are so designed that they will load well on a flat car, one car usually being sufficient to carry the framing and other material for one house. Such materials as brick, plaster, sand, etc, are not included, as they can usually be more advantageously obtained at the place where the house is to be built.

The accompanying illustrations show various stages in the erection of a house fabricated on this principle, the actual time required for erecting and securing the first story wall-framing of this particular house being thirty-eight minutes.

In order to raise further the standard of small house construction a number of precautions not usually considered are observed to insure lasting quality and a satisfied home owner. The first step is to provide a footing for the cellar walls; this is a layer of rich concrete six inches thick and eighteen inches wide upon which the concrete walls are built up. The effect of this is to insure an absolutely firm foundation, which prevents cracking or settling of the cellar walls and consequent sagging of the whole structure. Sills and other semi-exposed parts, such as window frames, are tarred or linseed oil treated to prevent absorption of moisture, which thus eliminates alternate wetting and drying so conducive to timber decay. Special care is taken when putting on sheathing. Ordinarily these boards are nailed on with little care regarding tight joints, and often there are spaces a half inch wide between them. The proper method is to use tongue-and-groove lumber put on diagonally, over which a layer of three-ply

Showing the sections being raised, and how they fit together

waterproof building paper is used. This waterproof paper is always used whether the finish be of clapboards, shingle or stucco, and insures a wall through which no dampness can penetrate. The diagonal method of sheathing adds further to the rigidity of the structure and takes care of any possible shrinkage. Instead of being merely placed in position, the cellar windows are set in concrete and well packed to prevent the entrance of draughts. Often a cellar window frame will carry so much weight that if made of light material it will cause the building to sag. The two-inch ash frames employed in making the cellar windows of these houses, however, are blocked in two places, as will be observed by referring to the cut. All window frames are flashed with zinc, which is, of course, non rustable, this being an important precaution which effectively keeps out wind and water Bay windows, which are usually a disappointment because of draughts which enter from below, are protected at this point with a sheet of heavy canvas, first shrunk in salt water, followed by several coats of white lead and linseed oil. In putting on the roof the utmost care is used. The best grade of ⅝-inch by 18-inch cedar shingles are used, being laid 5 inches to the weather, with galvanized non rustable nails, which makes the roof covering three courses thick.

Finished house built about a mill-made frame

Lining a Creek with Concrete

FORMS designed for quick and easy resetting as well as great adjustability to position on tangents or on curves were used in recent work during the deepening and lining with concrete of a creek channel in Syracuse, New York. The channel was deepened, after being unwatered, by a walking dragline excavator Progressing downstream from the end of the deepened channel the concrete invert was constructed All that was required in the way of forms for this invert construction were steel channels set to line and grade at the outside edges of the invert.

Five units made up the traveling form used for constructing the side walls. Mounted on double-flanged wheels, each unit was 14 feet in length The track on which the form traveled was laid directly on the concrete invert. Three rigid trusses spaced 6-inch centers and cross braced made up the individual units of the forms. Attached to arms sliding with the upper and lower chord members of the trusses were the steel faces of the forms against which the concrete was deposited. The face forms could be moved horizontally to gain adjustments in desired positions. The movement and adjustment of the face forms was controlled by three jack-screws at each end of each truss. This arrangement made it possible to insure absolute rigidity once the face forms were set.

The units were spaced four feet apart on tangent stretches of the creek. The intervening spaces were filled by planks for which grooves were provided at the ends of the face plates. The units, on curves, were set at a minimum distance of 12 inches apart at the top of forms on the inside of curves. Here the planking was cut to fill the existing intervening spaces.

After the forms were set, the track was properly alined between the two outer edges of the invert. Upon rolling the forms forward the form faces were jacked out to the back line or the earth face of the concrete side-walls. The space between the form-faces and the excavated bank was filled with earth and compacted by tamping After this had been completed the base forms were pulled horizontally away from the earth banks by the screw jacks about 17 inches and the space, 12 inches, to be filled was ready for pouring concrete.

A secondary traveler running on a track on top of the form trusses carried the concreting equipment Outriggers carried chutes from the hoppers on top of the cars to the side slopes. At this point the chutes emptied into other chutes leading down into the lining space. The concrete coming from a central mixing plant was lifted into the hoppers and chuted down to the spaces to be lined. The hoist on the secondary traveler car joggled the chutes up and down while pouring the concrete, and the chutes were raised also as the concrete rose in the space being filled.

A 90-foot section could be puddled and concreted in a working day by using these forms, it is claimed, and the framework was pulled ahead by its own power for the next day's work

Left: A close-up view of the form used for the concrete. *Right* The finished job

Making a creek over with concrete bed and concrete banks

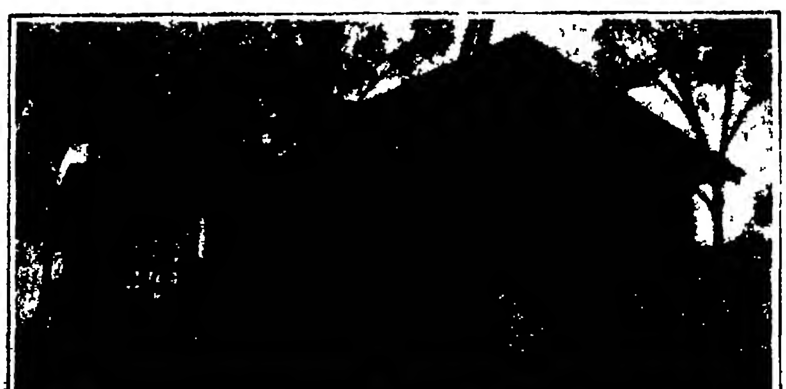
Garage the Dwelling-Place While the House Goes Up

WITH the building material market playing vigorously on the up-and-down scale and things in general still undecided, several prospective home builders in Lincoln, Nebraska have adopted a rather unique solution Rental of apartments maintains its stand at the same high rates, and with this in view the parties in question are erecting buildings on new and relatively low priced sites in the Peck's Grove addition in the edge of town These buildings are being furnished in beaver board and plaster to tide the families over the winter Next spring they will be vacated when the homes have been built, and then used as garages.

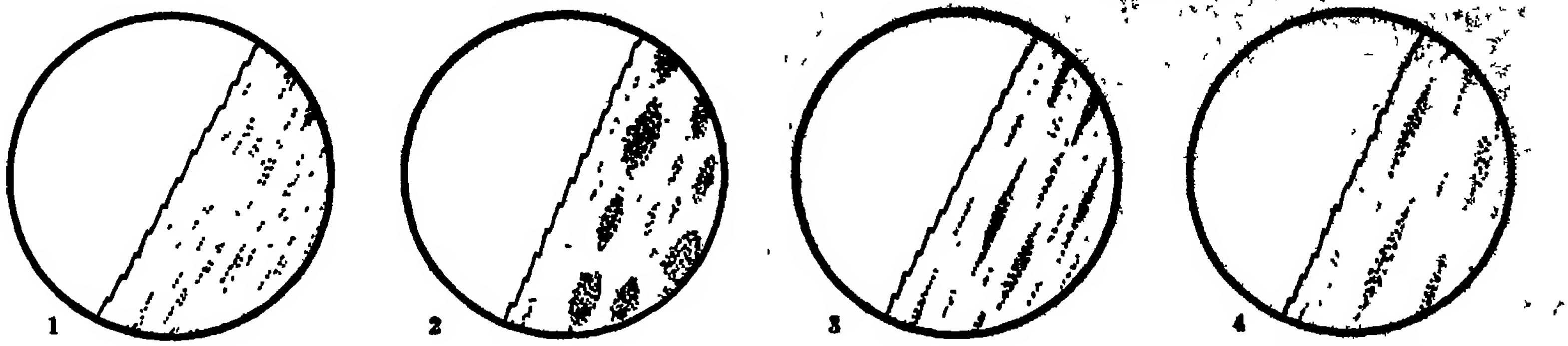
Mr Fred Yocel, a contractor, claims the idea as his. He put the proposition to one of his clients and the result was that the first building was started. The buildings as a whole are on temporary foundations. With the ultimate position of the residences well planned, the buildings are set in place though one or two of the tenants intend to move their structure in the spring and add it to the new home. One owner plans to annex the garage to the house and build a sleeping porch overhead.

The idea is growing in favor and several buildings of this type are being constructed at the present time With plans well laid, the ultimate program of building will go on next year and in the meantime the owners are enjoying home privileges with hardly any rental, and this adds a substantial sum to the amount to be allotted for the home building later

A resident of a Jersey suburb of New York has profited by this idea even more than his western contemporaries. He bought his lot in 1916, expecting to build at once Kiting costs prevented this, so he put up a two-room frame structure and made it comfortable inside He then beat the game further by practically building the permanent residence himself in spare time—he figured he had all the time there was to complete it in This summer, after his house was finished he moved out of the two-room quarters and rented these to the owner of the adjoining lot, who is now living in them while he builds his house Then the owner will convert it to a garage and demolish the shanty he is now using for his car



Beaver-board-and-plaster structure used as temporary residence during the construction of a permanent one, and then demoted to garage service



1 Chinese (black) 2. South African Bushman (black) 3 English (dark brunette) 4. Early Egyptian of about 4000 B. C. (light brown)

Highly magnified portions of shafts of human hairs of various colors and from individuals of various races, showing variation in the pigment-granule patterns

Human Hair Under the Microscope

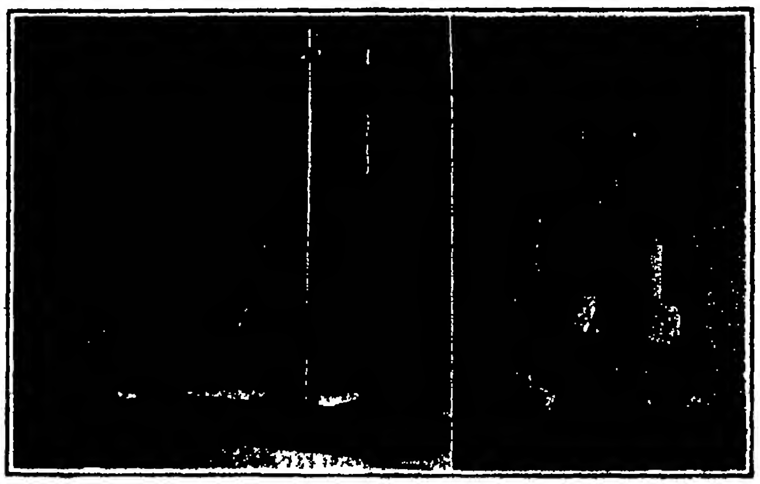
Recent Acquisitions to the Knowledge of Its Minute Structure, and Their Applications

By Leon Augustus Hausman, Ph.D., Cornell University

THE microscopic study of the structural elements in the human hair has, in recent years, begun to be of considerable value to investigators in several diverse departments of scientific research. Physicians and physiologists, detectives, anthropologists, archæologists, and others, are turning increasingly to the aid which the microscope can render in search of answers to some of their many questions. A few fragments of hair are found upon a murdered man's clothing, or in his hand. Are they his own, or some one's else? Of what race was this some one else? Man or woman? Hair dyed, or of natural color? Artificially waved, or naturally curly? Blonde, brunette, or red? Or the archæologist finds a mass of hair splinters in some ancient burial mound. Are they human or animal hairs? And if human, of what race? These are a few of the host of questions which a detailed study of the human hair under the microscope is helping to answer.

Grossly the human hair is a mere homogeneous shaft, minutely it is a complexly constituted structure, with definite elements found in definitely varying relationships. Fig 13 shows the three structural units of the shaft of a typical hair. Through the center of the shaft runs a core or pith, technically known as the *medulla*, composed of shrunken massed, distorted cells or chambers, more or less filled with air and connected by a ramifying series of cornified filaments which usually completely fill the medullary column. Surrounding this structure is the *cortex*, or main shell of the hair shaft, made up of elongate, fusiform cells almost completely coalesced and forming a nearly homogeneous and hyaline investiture. The outermost integument of the hair is termed the *cuticle*, and is composed of thin plates or scales of irregular outline imbricated like the shingles on a roof or the scales on a fish (Fig 14). The varying physical make-ups of these three elemental structures of the hair and their varying relationships produce the many different textures which we observe in hair from various individuals.

A fourth element in the hair shaft hitherto of seemingly little worth in connection with analysis of hair samples is the pigment. This is usually distributed among and within the closely compacted cells of the cortex, in the form of granules of definite shape, size, color value, and color depth. Moreover, the patterns formed by these granules within the cortex have been found by the writer to vary in certain definite and predicable relationships in hairs of different color and from peoples of different race. In some hairs pigment is found also among the cells of the medulla, and in the case of reddish hair it is present in the cortex as a general diffuse color and not gathered into masses or granules.



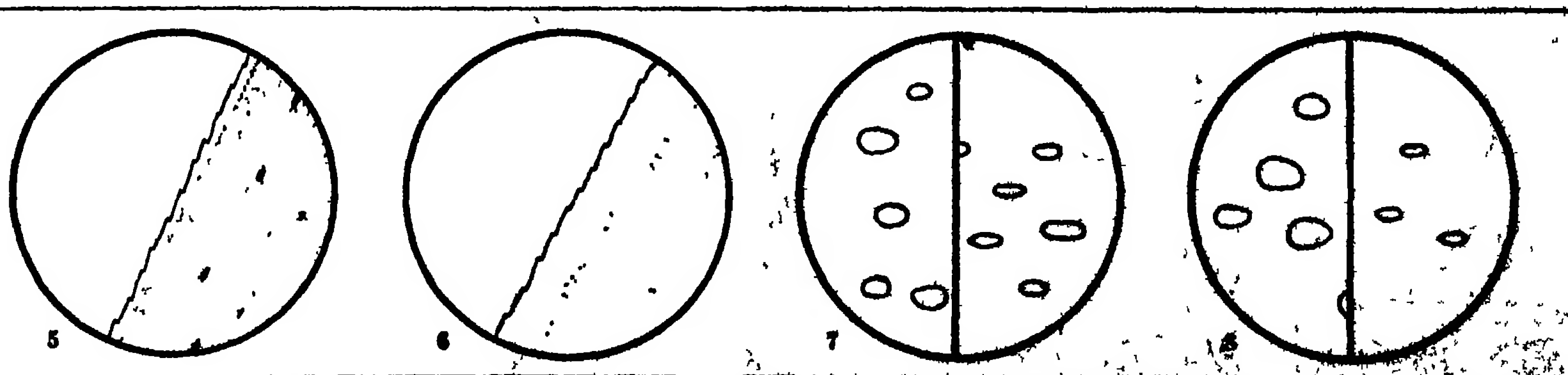
Left, Micro-mensuration apparatus. The greatly magnified image of the object under examination is thrown upon a scale located on the screen above, the course of the light rays being indicated by the dotted line. *Right* Two microscopes fitted with the comparison ocular which brings the two objects into the same field for delicate comparisons

Two of Dr Hausman's microscopic attachments which he uses for the accurate study of minute fragments of human hair

Figs. 1 to 6 illustrate some of the strikingly different characters of the pigment granule patterns to be found in human hair. In order that these may be clearly seen and studied it is first necessary to subject the hair fragment under examination to several processes, the objects of which are: first, to clean the outer surface of the hair from oily substances, and second, to render the shaft as transparent as possible without distorting the elements which compose it. Under the highest powers of the microscope at present practicable the granule patterns can be clearly discerned and even the form and size of the individual granules made out. Two minute fragments of black hair, one from a Chinese, the other from an English brunette, would hardly reveal the secret of their derivation except under such study. The different and characteristic granule patterns of these two hairs are shown in Figs. 1 and 3. The typical granule pattern in the hairs of negroes is shown by the hair of the South African Bushman in Fig 2. These granule patterns differ in the different races and tribes, but are in general in the shape of ovoid masses of varying sizes. Fig. 5 shows the appearance of so-called red hair. Here the majority of the pigment is diffuse in form, with larger masses of pigment than is usual in most cortices, distributed irregularly.

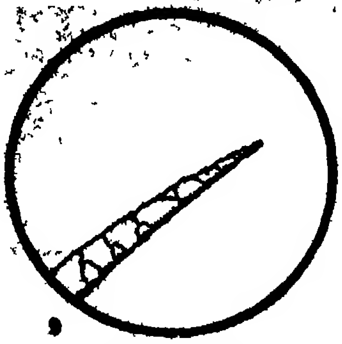
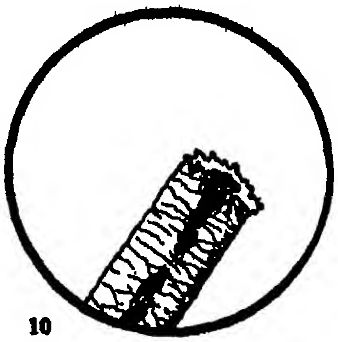
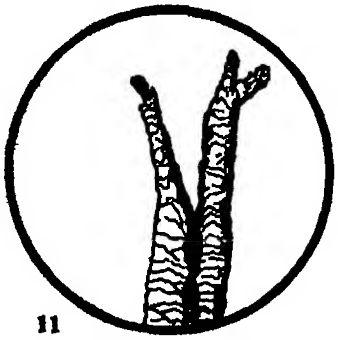
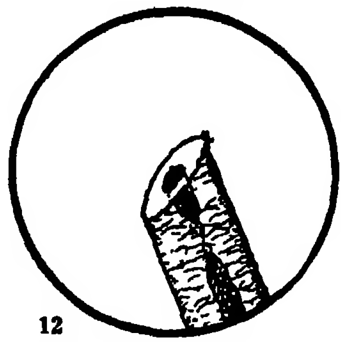
Not only are there marked and characteristic variations in the granule patterns, but also in the physical characters of the granules themselves. The most obvious of these are the variations in form and size of the granules. Figs. 7 and 8 illustrate the nature of these variations, as seen with the device known as the comparison ocular, shown in the photograph.

In making accurate determinations it is frequently necessary to record long series of measurements either of the granule patterns or of the individual granules themselves. For such nice mensuration the apparatus



5 English (golden red, pigment largely diffuse, with some few brown granules) 6. English ("[illegible]") 7 *Left:* American Eskimo; *Right:* Chinese 8. *Left:* [illegible] *Right:* "tow-headed" Englishman

Two more shaft views; and the individual pigment granules from hairs of four diverse individuals, as seen with the comparison ocular


9

10

11

12

9. Characteristic appearance of the uncut, natural end of a woman's hair. 10. Usual appearance of a man's hair, the end cut with scissors. 11 Hair shaft with broken end 12. End of hair shaved with razor

How the microscope reveals the treatment to which the hair has been subjected—a suggestion for the writer of detective fiction

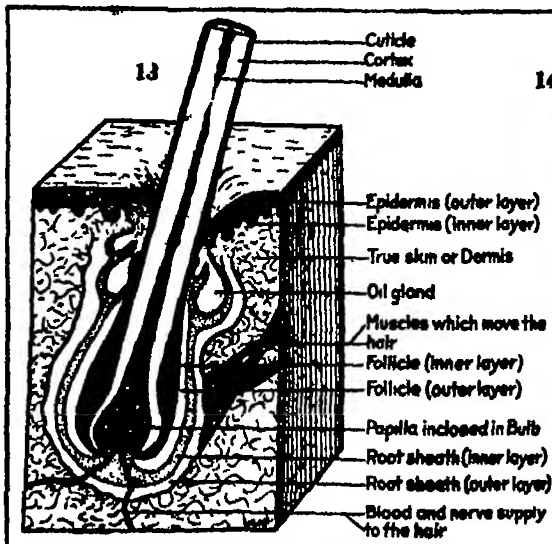
illustrated on page 112 is employed, and the greatly magnified image thrown upward on to a scale.

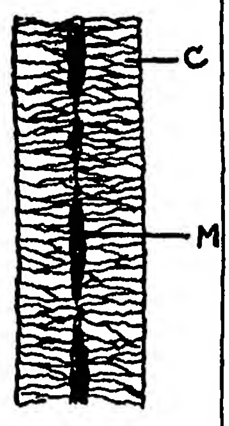
Not only are the forms and sizes of the pigment granules available as identification criteria, but also their color values and color depths. Some are dark brown, others yellow, others reddish. By the use of illumination, for the microscope, of standard color, direction, and intensity, accurate comparisons of color values of very minute fragments of hair shafts can be made. Because of the magnitude of the enlargements used for the study of pigment granules, photomicrography can not be successfully employed, except as a means of showing general features of hair coloration.

Work upon the pigmentation of hairs came about as a result of examination of a large series of animal hairs made by the author from 1915 to 1918. It was the possibilities of the forensic application of the study of mammal hairs in connection with the fur industries which led to a preliminary survey of samples of human hair of different color, and particularly from individuals of different races. At the present time it can be said that identifications of hair samples, and especially of minute fragments, are upon grounds of much greater trustworthiness than ever before. Minute criteria, of the sort discussed, have already proved their worth as aids in analyses, in forensic, archaeological, industrial, and purely scientific investigations.

The medulla and cuticular scales likewise show characters whose variations in form, size, and relationships also afford valuable aid in analysis. Fig. 14 shows the typical form of the cuticular scales and medulla of the average human hair These two elements undergo certain fairly definite modifications in the hair of different races, in hair of different colors, and sometimes in the hairs from different individuals. Studies in individual hair variation, with regard to the microscopic structural elements of the hair shaft, will well repay those engaged in medico-legal work.

One of the earliest usable series of data for the separation of peoples into races on the basis of minute hair characters was that perfected by a French professor, Dr. Pruner-Bey, who about 1858 pointed out that the shape of the cross-section of the hair shaft is consistently characteristic of race. By an extended series of examinations and measurements Dr Pruner-Bey showed that each of the various types of woolly, wavy, kinky, frizzy, or straight hair exhibited its characteristic *form of cross-section*. The straighter the hair the more nearly circular the outline of the cross-section, the curlier the hair the greater its ellipticity Thus the straight hair of the Mongols and American Indians presents a circular, or nearly circular, transection, while the woolly hair of the negroid peoples of Africa shows an elliptical one. (See Figs. 17, 18.)





13. Shaft of a single human hair represented in its place in the skin, a block of which has been cut out. 14. Typical form of the cuticular scales and the medulla of the average human hair

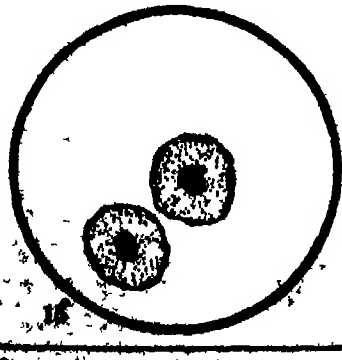
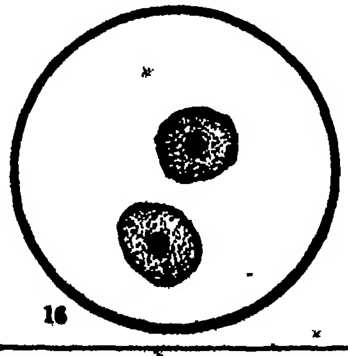
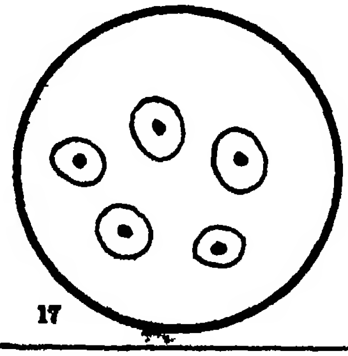
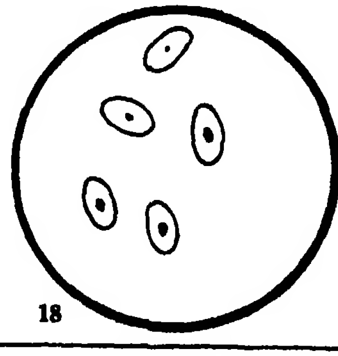
General structure and arrangement in the skin of human hairs

This basis for race classification has been long recognized as a rather precarious one A slight displacement of the hair shaft under treatment away from a vertical position with regard to the edge of the sectioning knife results in the formation of a distorted transection, and may change a circular cross-section into an elliptical one, or increase the index of ellipticity in a slightly elliptical hair

It is frequently helpful, or even vital, to know accurately to what sort of treatment a hair has been previously subjected And here again the microscope can help us, for almost any sort of treatment of the hair registers its effects in some modification of the delicate structures composing the hair shaft Hence it is that the microscopist can often determine whether samples of hair were taken from the head of a man or a woman, though it must be said that the recent fad of bobbing the hair has worked sad havoc with the reputability of this particular criterion! In general, however, the natural ends of a woman's hair present the appearance shown in Fig. 9, while those of a man's appear as in Fig 10 If a hair shaft be bent and broken apart its fractured end shows a characteristic and easily recognizable form, shown in Fig 11 A hair cut with a razor is shown in Fig. 12. These are some of the many separate bits of information obtainable through a microscopic examination of hair fragments. A tabulated series of observations of this sort is of great usefulness to the microscopist, who is called upon to search for answers to exceedingly nice questions, answers which lie, often awaiting only the proper treatment and examination to make them render up their aid

Trend of Automobile Design in Germany

A MARKED preference for 6-cylinder in the place of 4-cylinder motors is to be noted in the case of heavy types of car, while the 8-cylinder motor appears only in a few exceptional cases. Motors with overhead valves are being preferred on account of the greater reliability, higher efficiency and considerably lower fuel consumption due to the improvement of combustion chambers thus obtained A new type of motor has been produced by subdividing the cylinder head and carrying the crank case up close to the combustion chamber, as well as by using steel cylinders and aluminum pistons. Thanks to an extensive use of steel, it has been possible, *e g*, in the case of the Mercedes motor, to reduce metal masses in the cylinder head, thus allowing such motors to be submitted to heavy over loads. Moreover, there is a wealth of improved carburetors intended to deal with inferior kinds of fuel (heavy oils), fuel economizers, ingenious combinations of the igniter, starter and lighting dynamo, new and improved accessories of all kinds, etc, and much space at the recent Berlin show was allotted to these devices.


15

16

17

18

15. Cross-sections of a reddish-brown hair, naturally pigmented. 16. Similar sections of hair dyed with henna. Note that in hair thus artificially colored the cuticle is stained. 17 Sections through hair shaft of American Eskimo. 18. Similar sections in the case of South African Bushmen, showing increased ellipticity of the hair with increased curliness

Other details of hair analysis with which the microscope enables us to deal

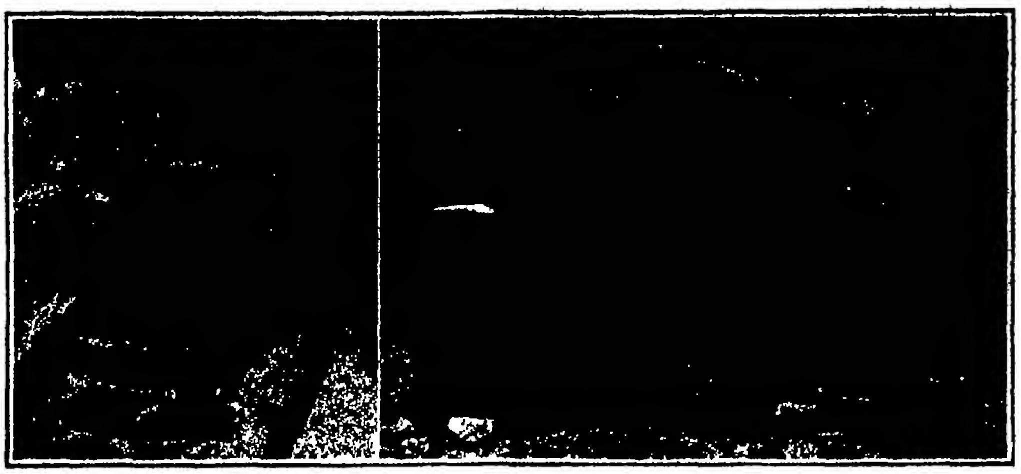
A Second Pompeii

Remains of an Ancient Metropolis Discovered Beneath the Cellars of Mexico City

By Fred Gilman Jopp

IS there a second Pompeii under Mexico City? Does the largest city of the south ern republic have, as a foundation, the roofs of an ancient city of which it knows nothing? Recent excavations have indicated that this surprising possibility exists.

While doing some construction work, one of a party of workmen in the heart of Mexico City suddenly disappeared from view. In the process of rescuing him from the deep pit into which he suddenly fell it was discovered that he had literally fallen into another town. Naturally, great excitement at once prevailed and crews of workmen were at once brought to the place and started on the work of removing the ground level of the modern city.



Left: The stone serpent that guards the entrance. *Right:* The bake-oven of bygone years

Some of the sights seen on breaking through the lower crust of Mexico City

When this was done, and the existing earth removed, it was found that a complete building, in excellent condition, was supporting the supposed solid ground. Walls of rock, not a bit crumbled, divided the house into rooms and passageways of various sorts and depths. Tiled floors, comparable to modern tiled floors, were found intact, and other elements of building construction indicated that the builders knew as much of the principles of construction as modern contractors and architects.

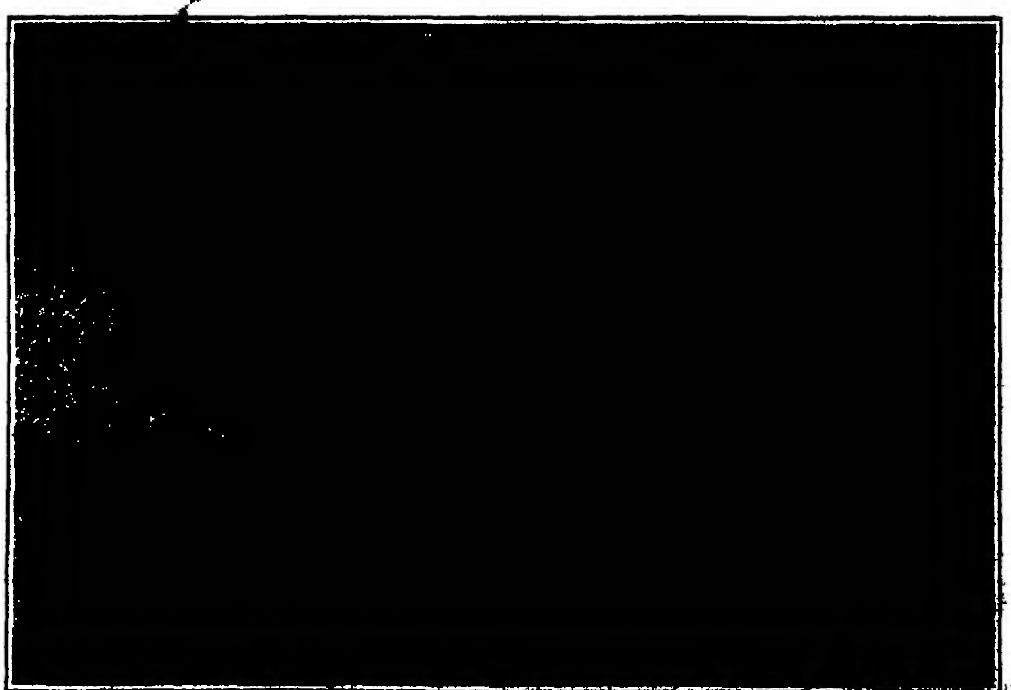
Most characteristic of the builders of the ancient city were the carved stone images found in the walls and about the floors in various places. Of these the large stone serpent which guarded the entrance is probably most noteworthy. This huge affair has been carved out of the hardest stone with an exactness that would do credit to a marble worker of the present day. Detail to the extreme is to be found in this figure, yet the instruments with which it was fashioned must have been altogether crude.

In another place a complete bake oven in perfect condition, built of adobe bricks, was unearthed. According to scientists, the presence of the bake oven would indicate a fairly high type of civilization among the residents of the mysterious city.

A pile of "nails" for use in further construction work is of great interest. These consist of stones, pointed artificially at one end. A pile of hundreds of these is surprisingly uniform. To fashion them from the hard rock of which they are made must indeed have been a tedious task. Apparently the inhabitants had intended to do further building, for there were many of the "nails" stacked up in a pile, ready for use.

The bricks used in the walls are of two kinds: first, those made by chipping rocks into regular shapes and, second, those made of adobe mud. In the case of the bricks made of stone, the walls are frequently built sloping back instead of straight up, evidently to avoid a cave-in or slide. The walls are extremely thick.

Now that this much has been unearthed, Mexico City residents are wondering what lies under their own property. Is it possible that a whole underground city is there waiting to be uncovered? Or is the ruin that has been discovered simply that of an ancient Mexican dwelling that has been gradually covered up and forgotten? Advocates of the latter theory cite the recent finding of a complete boat under a San Francisco city lot as support for their theory. Many, however, are equally positive that under the modern city lies a second Pompeii, waiting for someone to dig it up again. And still others, who take little interest in the situation one way or the other, are speculating about a more practical question. They are wondering just how secure the foundation of their property is. The possibility of living over an ancient city, with one's dwelling supported only by wedged earth, is not exactly conducive to the most comfortable of feelings.



A view down into the excavations of the old city being uncovered under Mexico's capital

Quantum Theory of Color Vision

IN a recent number of the *Proceedings of the Royal Society* (London) Mr. J. Joly, Sc.D., F.R.S., has an important paper on *a quantum theory of color vision*. Introducing his paper, the author says that he takes the view that the sensation of light is in every case stimulated by the action of photo-electrons set free in the retina. Further, the energy of the photo-electron being proportional to the frequency of the light, the strength of the stimulus produced is the all-sufficient origin of the color sensations. That color is entirely a cerebral phenomenon is evident. Light, visible and invisible, consists of a uniformly graduated series of wave motions or energies. There is nothing to distinguish one part of the spectrum from another save the difference of wave-length or frequency. But objects in nature react differently toward these waves, absorbing some, reflecting others, and so the selective effect of natural objects toward light has discovered to the organism a means of improving on monochromatic vision; a means of distinguishing objects by their selective absorption and reflection. Our color sensations were developed solely for this purpose and solely under the influence of the light reflected by natural objects. Hence a limited number of fundamental sensations being the simplest, if not indeed the only, way of securing the desired end, we should expect that these sensations would be developed so as most effectively to interpret the frequencies met with among natural objects reflecting solar light. The evolutionary attainment of three highly developed color sensations according to the extreme and mean regions of the spectrum is the result. Color sensations, *i.e.* (white) red, green, and blue, were evolved, whereby the whole gamut of the spectrum can be dealt with.

The conclusion is reached that the number of spectral quanta converted to electronic energy and thereby rendered capable of exciting vision is controlled by the light absorption and bleaching of the visual purple (or substance possessing a similar spectral absorption curve). The quanta, increasing in energy from the long to the short wave-lengths, stimulate two, three and four fibers of the cone according to their energy, as shown by the color sensation curves. The simultaneous stimulation of two fibers is attended by the red sensation, of three fibers by the green sensation, of four fibers by the blue sensation. The unit of luminous stimulus is the nerve discharge of one fiber. No color sensation is associated with this stimulus.

The relation of luminosity to color sensation is, therefore, according to the author's theory, *as follows*: Luminosity is the more primitive sensation, and at first was associated entirely with rod vision. The evolution of the cone brought in multiple stimuli, and the sensation evoked became correspondingly complex. The basal luminous sensation remained, excited as before by a nerve stimulus from the retina, but it was accompanied now by a new and additional sensation, that of color.

Color sensation necessarily involves luminous sensation. It necessarily involves it because the energy is there which excites it. The converse proposition is not, however, true. It is not true because there may be insufficient energy to excite color sensation. The separation of color sensation from luminous sensation is therefore impossible.

The quantum theory occupies a large place in modern physics; but it is doubtful whether any of its applications are of greater interest than this one.

Meteorite Glows for Three Hours

A GREAT meteorite, three feet in diameter, fell on a hill near Tammin in Western Australia on the night of September 2. It continued to glow for three hours after striking the earth. The light was strong enough to show the neighboring trees.

Measuring in Millionths

The Latest Recording Ultramicrometer, a Device with Instantaneous Action

AMONG the interesting apparatus displayed for the first time at the recent British Association meeting (September, 1921,) was the recording ultramicrometer developed by John J. Dowling, M.A., of University College, Dublin. The principle underlying this device is best understood from the following experiment, but it must be stated that the particular valve circuit here dealt with is only one of several that may be utilized. For certain purposes other arrangements are more suitable.

In Figure 1 the coils XY, YZ are small pancake coils suitably placed by trial so as to make the apparatus function as described below The condenser C is formed

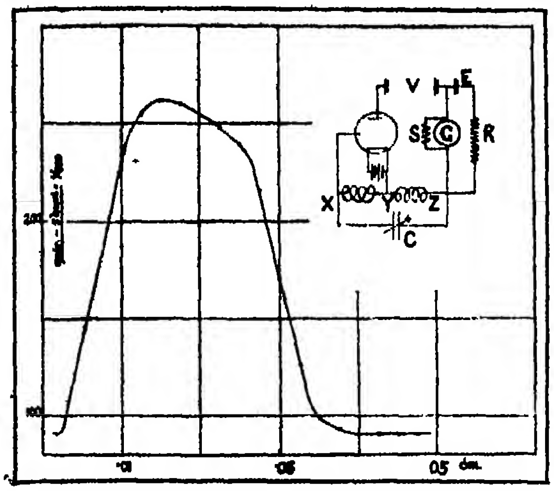


Fig. 1 The experiment upon which the action of the micrometer is based

by two small disks tuned reasonably true. The relative motion (normally) of these produces alteration in the capacity which causes corresponding changes in the anode current, and it is this anode current variation which is measured by the galvanometer By means of the "zero-shunt," consisting of a few cells E and the resistance R both in parallel with G, it is possible to employ a sensitive galvanometer to record only the *changes* in the anode current, I, in the neighborhood of a particular valve thereof. If the resistance R is great compared with the galvanometer resistance, it is easy to see that practically all the difference, dI, of the anode current, I + dI, from the "standard" valve will go through G Very minute changes in I are thus recorded.

The curve represents the variation in the anode current as C is changed—the variation in C being expressed in terms of the readings of a micrometer screw which moves one of the plates. It is obvious that over two parts of the curve the variation of I with the displacement is a simple linear one. This is a fact of great importance in simplifying the employment of the device. By employing the "zero-shunt" the galvanometer shunt S can be dispensed with, and, if the apparatus is functioning *anywhere* on one of the straight parts of the curve, the extraordinarily minute displacements of the condenser plates are recorded by the galvanometer In the example shown a displacement of less than .0000001 centimeter was detectable.

The apparatus, when adjusted to very high sensitivities, has to be screened as is usual in wireless work, but it is quite steady and recovers instantly from an accidental disturbance. The "inertia" of the galvanometer is probably a large contributing cause of this steadiness.

The applications of the device already worked out include the following, and patents have been applied for covering these.

Both in the physical laboratory and in engineering the measurement of minute strains, displacements, expansions and the like can be carried out with a degree of refinement altogether out of proportion with the simplicity and reliability of the apparatus. All these can be made from a distance and can be recorded by a recording galvanometer if desired. Both transverse as well as longitudinal strain has been measured on quite small specimens (2 inches by ¼ inch square) and thus *all* the elastic constants determined.

Weighing devices have been developed For example, a balance weighing 200 grams to the nearest milligram was shown in which the micrometer device was used to indicate, instantaneously, the difference between the weight of the substance required and the nearest whole number of grams. To use it, weights are removed from one scale pan until the sum of the remaining weights *plus* the substance differs by a fraction of one gram from 200 grams. The scale reading then directly records the outstanding difference in milligrams. A balance acting on this principle is dead-beat in action and enables an accurate weighing to be obtained in a few seconds instead of several minutes—a great desideratum in many cases. A suitable modification of the "spring" enables weights of, even, tons to be determined with equal percentage accuracy

On similar lines an apparatus is being developed to enable minute variation in gravitational force to be observed. The decrease in weight of a kilogram when raised one meter can be readily observed

If one of the condenser plates is carried on a flexible diaphragm, minute pressure differences are recorded with great ease Using a rubber diaphragm one millimeter thick, pressures of less than .0001 atmosphere are measurable to one per cent Such an apparatus, a rough model, was shown

Incorporated in seismometers such considerable magnification is obtainable as to make it possible to introduce enormous damping Much smaller instruments are likewise possible, while great sensitiveness and its concomitant delicacy of adjustment are no longer so necessary in the seismometer instrument itself

The measurement of the "growth pulses" of plants is another problem to which the apparatus has already been applied (*Nature* June 23, 1921) and, in its most sensitive form, it promises to yield valuable results in this as in other fields of research

The foregoing particulars are in respect to the actual apparatus exhibited at the meeting of the British Association in Edinburgh. As a matter of fact, however, the inventor has obtained much higher sensitivities with the apparatus set up in the quieter surroundings of the laboratory. Although the micrometer itself does not appear to be much affected by vibration, etc., the condenser portion cannot always be made rigid (*e.g.*, a pressure gage) and this is then liable to cause fluctuations if disturbed Another point, already mentioned, is the necessity for proper shielding of as much as possible of the apparatus when very sensitive.

The Dowling ultramicrometer, completely assembled

For calibration at these high sensitivities the device shown in Fig. 2 is used. The two 10-centimeter circular condenser plates (a) are carried by the ebonite collars (b) by means of suitable levelling screws and springs. The steel rod (c) passes through large holes in the collars and disks, but the former are held tightly on the rod by sets of three set-screws (d) which meet the rod on two circles 5 centimeters apart. The rod is screwed vertically into a heavy base and carries a small table above Any desired small compression can be given the rod by placing weights on the table, ½ kilogram actually causes 5 centimeters of the rod to contract .000001 centimeter, and the condenser plates are therefore moved just this amount.

Pressure gages of moderately high sensitivity are calibrated by the drop in pressure along a 1-centimeter tube when a current of air is drawn through at a

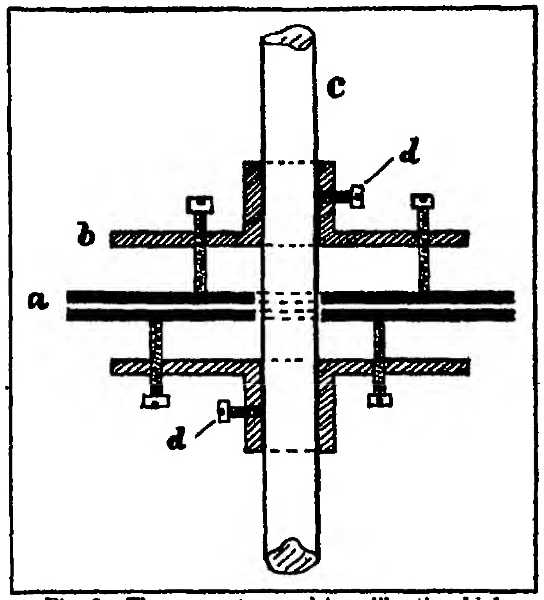


Fig 2. The apparatus used in calibrating high sensitivities

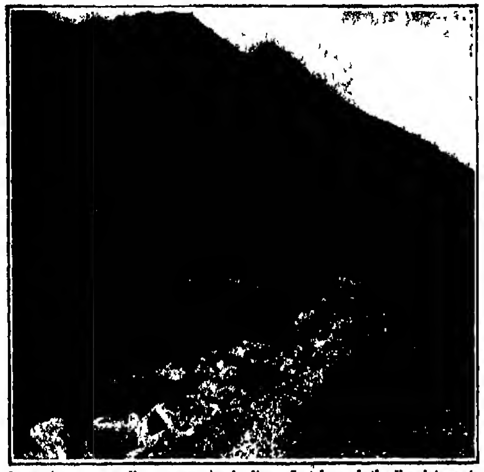
measured rate. Pressure differences ranging from 1/10 to 60 dynes per square centimeter are readily obtained in this way, and there are no troubles from temperature effects. In this way several gages all made with stout rubber diaphragms one millimeter thick have been tested. As regards constancy of zero, steadiness, quickness in response, and sensitivity they leave nothing to be desired, and each one can be varied in sensitiveness at will by shunting the galvanometer

One or two points remain to be dealt with which arose in course of discussion at demonstrations. Mr Dowling has tested the sensitiveness of micrometers at intervals while the valve circuit was kept in oscillation and also from day to day, in every case the sensitivity was found constant, provided that the filament battery was in good condition. Similarly, after "starting up" a minute or two suffices for steady conditions to be reached The inventor attributes this steady behavior to the valves being run at low voltages.

Resources of Jugoslavia

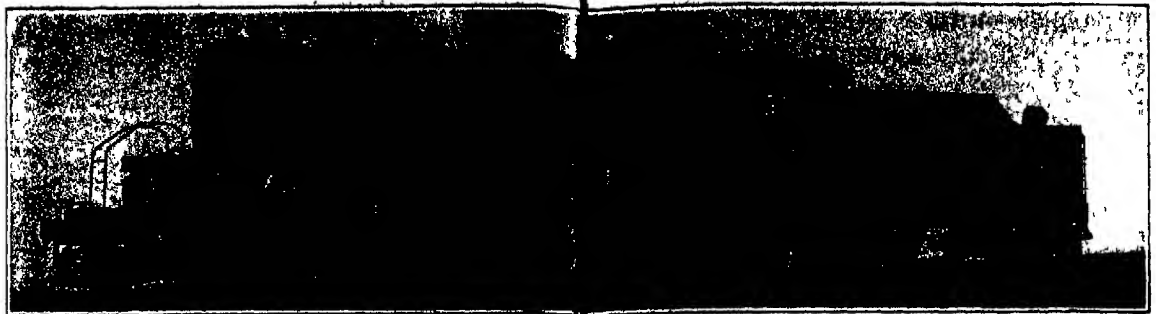
THE *Revue des Balkans* states that Jugoslavia's immense resources of prime materials have been very little exploited up to the present because of lack of labor and capital. The wood industry holds first place in the country, one-third of which is covered with forests. The textile industry is still in a primitive condition It has some 60,000 spindles and 2300 looms. The clothing and carpet industry are important in Siberia, but these enterprises are suffering especially from lack of cotton. The iron industry is very little developed. The annual output of raw iron is 2,000,000 tons. The deposits of magnesium in Lublja have not yet been exploited, although the annual production is estimated at 45,000 wagons. The sugar industry is well developed. The six sugar refineries of the territory obtained from Hungary can practically satisfy the needs of Jugoslavia.

Concrete culvert, built to pass the storm waters during freshets. Note the old Chinese wall on the crest of the hill



Inspection car rounding a curve in the line. Just beyond, the line intersects the Chinese wall

Note the deep broken stone ballast and bank protection against freshets



Largest Mallet freight locomotive outside of America; built for the Peking-Suiyuan railway, China. Length over all, 94 feet 9 inches, total weight, 320 tons

中華國 The Peking-Suiyuan Railway of China 有鐵路

A Road Surveyed, Constructed and Operated Entirely by the Chinese

IN these photographic illustrations of the roadbed, rolling stock and locomotives of the Peking Suiyuan Railway in China we have concrete evidence that the Chinese, who antedated many of the inventions, discoveries and engineering constructions of modern days, can become thoroughly efficient when they set themselves to master the principles and practice of the most up-to-date engineering accomplishments of our times.

We ought not to be surprised at this revelation, we ought rather to be surprised that the modern industrial awakening of China did not happen long ago. For so far as history and archaeological evidence are concerned, the Chinese were not only among the earliest, if not, indeed, the very earliest, to construct engineering works, which we are apt to consider as modern in their conception, but they built upon such a scale that many of their structures would be notable for their size even in the present day It is believed that the first iron chain suspension bridge was built by the Chinese, and it was built so well that it is in use today Centuries ago they crossed some of their greatest rivers with stone bridges which are still in good condition, one of these being over 4000 feet and another considerably over 5000 feet in length They were among the earliest to appreciate the merit of the stone arch, and they built it on a scale that was ambitious for those early days, and some of their later stone arch bridges, notably the one illustrated in our issue of November, 1921, possess decided architectural fitness.

The Peking Suiyuan Railway should be particularly interesting to Americans because of the fact that it was built by engineers who received their training at American universities. The greater part of the line was constructed under Dr Jeme Tien-Yow as chief engineer Dr Jeme graduated from Yale in 1881 and rose to be the most prominent Chinese civil engineer On his death a few years ago he was succeeded as chief engineer by Mr K. Y Kwong, who graduated from the Massachusetts Institute of Technology in 1881 The influence of the training of these engineers is seen in the character of the Peking-Suiyuan Railway, as shown in the accompanying illustrations. The roadbed, ballast, ties, joint fastenings, et cetera, are all essentially of the American type, and, indeed, would pass muster on the best of our railroads. Also it is evident that the maintenance-of-way engineer and the section foreman and their gangs are efficient, for the line has the appearance of receiving careful attention. The ballast is deep and ample and the alignment and surfacing of the rails appear to be everything that could be asked.

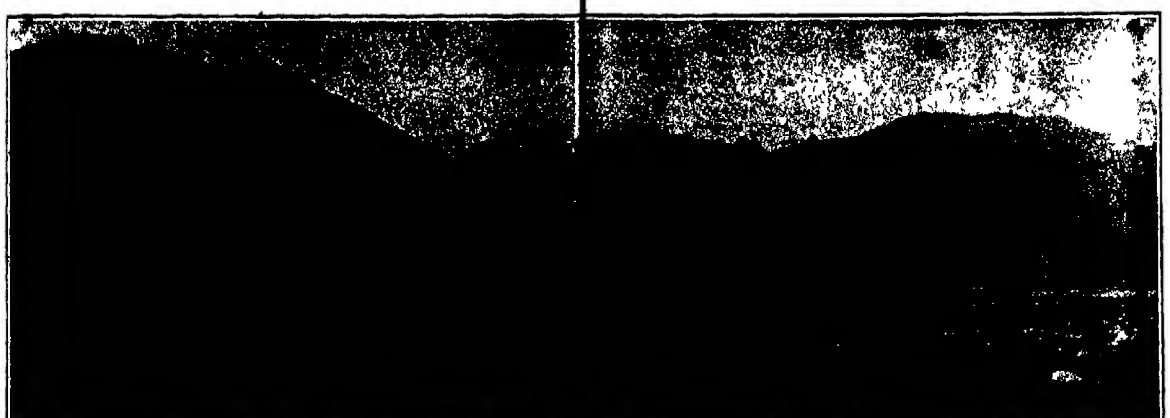
The Peking-Suiyuan Railway connects with the Peking-Mukden and the Peking-Hankow Railways at Fengtai, runs along the west wall of the Chinese and Tartar cities of Peking and then extends in a northwesterly direction to Nankow over the West Hills, via Nankow Pass, to Kalgan, and thence to Fengchen and Suiyuan. The total length of the line is 357 miles. There is also the Mentowkow branch which leaves the main line at the northwest corner of the city of Peking and runs westerly to important coal deposits 16 miles distant

The country through which this railway passes, judged from the standpoint of railway construction, varies from fairly easy to moderately rough, with some heavy work where the line is carried across the West Hills on a 3.33 per cent grade. It called for the exercise of good judgment on the part of the locating engineers and necessitated some costly work to insure the permanent integrity of the line. Thus it will be evident that the river along which the line was developed is subject to heavy freshets, as shown by the precautions which have been taken to protect the embankments from erosion and undermining There was a large amount of riprapping to be done, and one of our views, for which space could not be found on this page, shows what is apparently the Chinese substitute for our mattress protection, as used in connection with the levee work of the Mississippi River In this case the bed of the river adjoining the embankment is protected by large slabs of concrete, which should afford a durable protection. Attention is also drawn to the character of the masonry as shown in a culvert and at the portal of one of the tunnels.

The first stretch of the line, known as the Peking-Kalgan section, which is 122 miles in length, was commenced in 1905 and finished in 1909 The funds for its construction were appropriated yearly out of the surplus earnings of the Peking-Mukden line, after deduction of the payments of the six months' interest and capital for the loan As the Peking-Kalgan Railway was nearing completion, the board of communications considered the extension of the line from Kalgan to Suiyuan. The undertaking received imperial sanction in 1909 and work began in the following year The length of this line is 235 miles.

Revenue from the freight on this line constitutes about 75 per cent of the earnings. The other 25 per cent is received from the passenger business. The preponderance of tonnage is toward Peking and the Fengtai connection with the Peking Mukden Railways. This affords the advantage of a down-grade haul over the heavy 3.33 per cent grade across the West Hills. The larger part of the freight consists of agricultural and pastoral products. As we have already stated, this interesting railroad is entirely the work of the Chinese Thus the bridges for the line were largely fabricated at the Shanhaikwan bridge works of the Peking-Mukden Railroad. The 85-pound rails and joint material came largely from the Han Yeh Ping steel works at Hankow Much of the other material, such as switch stands, has been purchased from time to time in America Most of the passenger and freight car equipment on this line was built at the Tongshan shops of the Peking Mukden Railway although a relatively small amount is of American manufacture.

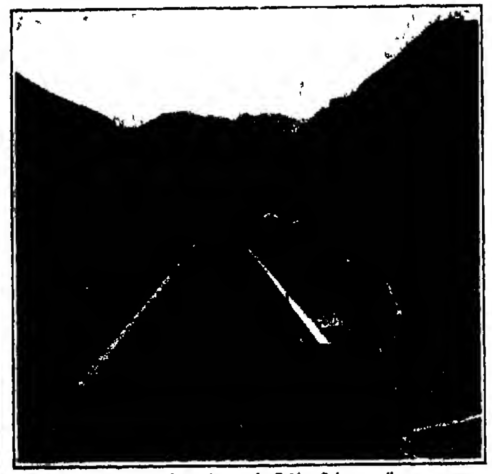
Most of the locomotives are American built Chinese railroad men on this line are justly proud of the fact that the heaviest and most powerful locomotives, not only in the Far East but in all the world outside of America are to be found on the Nankow grade These engines, as shown in the illustration at the head of this page, are of the Mallet type and were built by the American Locomotives Company, who have already despatched several of them to this up-to-date Chinese railroad.



This fine bridge was designed by Chinese engineers, fabricated in American shops, and erected entirely by Chinese labor

A junction and station showing types of rolling stock, most of which was built in the Chinese car shops

The Peking-Suiyuan railway was surveyed and built by the Chinese. This tunnel portal shows the excellent character of the masonry



Typical wayside station on the Peking-Suiyuan railway

A Question in National Resources

The Importance of a Central Station for Peat and Muck Investigations

By Alfred P Dachnowski

Physiologist, United States Bureau of Plant Industry

TO know anything that is today of fundamental interest about peat deposits, they must be analyzed in three coordinates—in their space and time relations and in their energy value The estimates which have been made of the areas of peat and muck land distributed over the United States are quite unlike (*Soil Science* 10 453-465—1920) but the stratigraphic method—indicating the nature of the plant remains and the order in which layers of peat material lie upon one another in the deposits—offers the basis for a careful consideration of the acreage and geographical distribution of peat deposits which more properly constitute the reserve of profitable future farm land The stratification of peat deposits, and the animal and plant remains imbedded in them, is moreover of high importance to geologic climatic, and biologic research (*Botanical Gazette* 72 57-89, 1921) Although the specialists engaged in these studies are few, their investigations are of much value, since they indicate the relative age of these deposits and the time periods in the past history of the country, when the beds of organic material were formed. The different types of peat material which supply the essential criteria concerning the physical, chemical, bacteriological and other merits of workable tracts of peat and muck can now be studied as sources of energy in coordinated effort and without difficulty (*Bulletin 802, U S Dept of Agriculture, Bureau of Plant Industry*, 1919) Some of the localities have been indicated (*Botanical Gazette* 72 61 1921), near which layers of peat material are displayed in typical form at or somewhat below the surface of representative peat deposits.

The chief purpose, if not the most important one of all in the problem of peat and muck lands, however, is to enable one to form some reasonable estimate of the future course of practical usage, the future agricultural and industrial development of peat and muck land, so far as that is governed by economic conditions. Such an estimate must also be based on one's knowledge of the profile structure of these deposits, the materials of which the different layers consist, and the field conditions that can be seen in operation at the present time or in the near future In attempting such forecasts laboratory studies, experimental results, and statistical data, including crop production and demand, are unquestionably an important aid One of the greatest advantages which the future may be expected to have over present information concerning the relative value of peat and muck lands will consist in the greater accumulation of comprehensive, exact data. The better insight as to the kind of information collected will help to distinguish the important from the unimportant peatlands and will direct attention to the methods most worthy of handling these deposits.

In relation to the common welfare the problem of a safe and profitable utilization of peat and muck lands is a serious one These areas represent not only the last unused natural resource of the country in both land and raw material, but the prosperity and well being the maintenance of many rural communities in states having a large acreage of peat deposits depends upon the possibility of increasing the usefulness of these "waste" land areas. Economic and social considerations demand a keener interest than has been enlisted thus far in helping to meet and solve the peat-land problem to the fullest degree possible.

Peat-Land Crop Possibilities

In almost all relations between larger private enterprises on peat lands and public service an unconscious movement is seen toward cooperation There is a growing conception of the futility of individual effort to encompass the necessary knowledge and the measures needed for the commercial expansion and rapid development of peat and muck areas. Experience has shown that many complications are inherent possibilities. Exploitation of peat deposits has for so long outrun an understanding of their structural differences and relative value for live stock and dairy farming, for general crop management, and for the manufacture of peat products, that even among laymen the operations and results on most peat lands are known to fall far short of their possibilities. Peat land agriculture is not different from a manufacturing plant, both should know at frequent intervals just what progress they are making and what changes must be made to avoid damage.

It does not seem necessary to advance many arguments as to the value of collecting, accumulating and disseminating fundamental information relative to the agricultural development and management of the immense and varied peat land resources. The farmers themselves see the need of more complete knowledge of how to get better crops from peat and muck soils, and they are willing and ready to adopt a coherent program of drainage, of crops and new plant varieties suited to these soils and to the markets, and of properly balanced fertilizers for the particular types of peat deposits, to replace the guess work and uncertainty. A beginning should be made by applying on selected peat areas the scientific principles and methods that come from the laboratory and the field plots of a central station for peat land investigations, so that definite information may be given on the underlying causes of success in these matters. The trend is decidedly toward a larger use of peat and muck land, consequently to a more varied and diversified agriculture Peat deposits, therefore, must be given their proper place in a system of farm management That this should be done within the next few years is particularly vital to the tendency toward an organized agriculture. To meet this new movement the peat land issue should be faced with the willingness to consider most carefully peat land utilization with respect to the country's future requirement. The answer to the problem of both producer and consumer lies in making the better quality of peat and muck land work to better purpose The production of highly speculative special crops, such as celery, onion, and mint, appears to be a success only on the *heavy* peat soils, on deposits which show a profile structure of aquatic types of peat alternating or intermingling with more fibrous layers. On the other hand, the *light* peat soils from marsh, bog and forest types of peat appear to meet the demands of diversified farming. It is obvious that these fundamental differences in types of peat form a sound basis for systems of crop management and for industrial plans of developing peat deposits. They represent differences in potential energy which should be known from various standpoints of scientific research The years of experience of the practical peat land farmer are valuable points of departure The practices of the competent and successful farmer are at present the only guide of value to the inexperienced prospective producer on peat land, whose observations are confined to crop varieties and practices on mineral soils. But if distinct and far-reaching progress is to be made in the intensive and extensive utilization of the different peat and muck lands, then the establishment of a central station for peat and muck investigations becomes a fundamental prerequisite

> *THE peat deposits of the United States present today one of the great fields for productive work in a wide range of activities There is a continuous demand for definite and significant information regarding the usefulness of peat and muck lands The interest is widespread and there is a pressing demand for a thorough consideration of these areas by state agencies, communities, and private owners A great variety of important problems confront the investigator and the practical man as well. Mr Dachnowski in this article states some of these, and indicates the direction in which he believes a solution to lie*
> —THE EDITOR

The lack of information concerning the nature of peat deposits and the properties of the raw materials injures the standing of the peat-land industries with the general public Both have been left a prey to misinformation, and the road is still open for the promotion of impractical fuel and fertilizer operations. There are many obstacles in the way of attainment, and the problem is peculiarly difficult. The process of dewatering the raw material, the seasonal nature of the production, the distribution of suitable types of peat and the varying volume in different deposits raise problems that make an accurate estimate for the future a difficult task However, this should not deter manufacturers of peat products from going at the question with the determination to get the best solution possible. It is to the greatest interest of all that these industries should be stable and fundamentally and economically strong. The margin of profit is certainly more available in the coming years if the basic materials, their distribution and properties are known far more intimately than heretofore, and if well-defined standards might be set up and made available for use by the whole industry Abler operation and better results can come only from a thorough investigation of the subject. This procedure would not only help to eliminate misinformation and place the peat-land problem upon a higher plane, but also it would bring an element of stabilization beneficial to all activities in peat and muck. It would meet with the approval of banking institutions, state security commissions, farm loan boards, and insurance companies who, at present, find themselves constantly handicapped in the extension of financial aid by the lack of scientifically determined criteria of peat-land values.

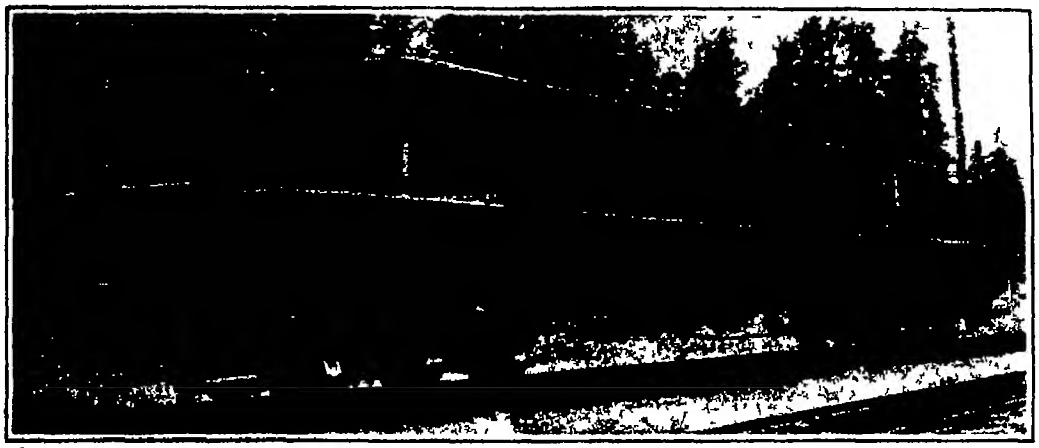
Power from Peat Lands

In the states in which peat and muck areas are most extensive a cooperation between agriculture and industry appears to be the only feasible method of increasing the usefulness to a community of its peat lands. The striking feature in this cooperative movement of the immediate future is the fact that the state and the community, the farmer together with the manufacturer, must play a part Just how this cooperation shall be effected and how it may be brought about is a problem of no small concern It needs a very thorough consideration and an able guidance, for it is a question of values and the proper functioning of different agencies in an organized enterprise The generation of power at peat deposits and the transmission of this power in the form of gas or electric energy is looked upon as one of the coming engineering possibilities for economy and cooperation This project lies at the basis of several superpower surveys which different governments in Europe are now making with the view of the application of power to large-scale agricultural and industrial activities. There are peat deposits in several states in this country which offer a profitable location for power projects complementary to farming and manufacturing purposes. For this reason investigational, experimental and statistical activities must be undertaken on a larger scale than that done heretofore. A national institution for peat investigations is the right place to undertake this work, to sift the information, and to use it properly for the benefit of all. It would remove a vast amount of duplication by many states and private agencies now gathering uncoordinated data, and it would result in a saving of public funds and of needless expense There is no justification for the assumption that research in peat and muck lands can be suspended or dispensed with entirely The leading countries of Europe have materially increased their appropriations for this work, for there, as elsewhere, peat deposits are the future granaries for increasing populations and rapidly growing industrial centers. The volume of literature from these stations sufficiently denotes that the personnel is devoting its entire time and attention to special problems in the technology and plant industry of peat lands The knowledge and experience emanating from these scientific and unbiased agencies leads to conclusions in which all may have confidence.

There is, therefore, a direct relationship which a central station for peat investigations bears to the future development of peat and muck land. This is so important that the value and functions of such an institution cannot be stressed too strongly Its public service is to discover what are the best things in science and practice as applied to peat-land agriculture and peat industry. College and station workers are looking more and more to a national institution for peat investigations for correlation, suggestions and assistance on many of these matters. The work done in the past is insignificant compared with what may be accomplished in the future. The foundations are already laid. Efforts in this direction have not been heralded by wide publicity, the work has been done quietly but none the less effectively. But there is need of further support in enlarging the work to a more unified national peat-land policy in order that it may represent the best thought of the manufacturer, the farmer and the scientist under the best practices which can be developed.

Something New in Observation Cars

IN order that its passengers may enjoy the scenery to the utmost, the Chicago, Milwaukee & St Paul Railway has recently introduced the new open air observation car shown in the accompanying view The car, it will be noted, is open on the sides above the top of the seats. The seating arrangement follows the general lines of a sleeping car, and a windshield is provided between each section. The roof covers that portion of the car taken up by the seats, leaving an uncovered section some eight feet long at each end of the car, as shown.



New type of observation car recently introduced on a Western road in order that passengers may enjoy the scenery to the utmost

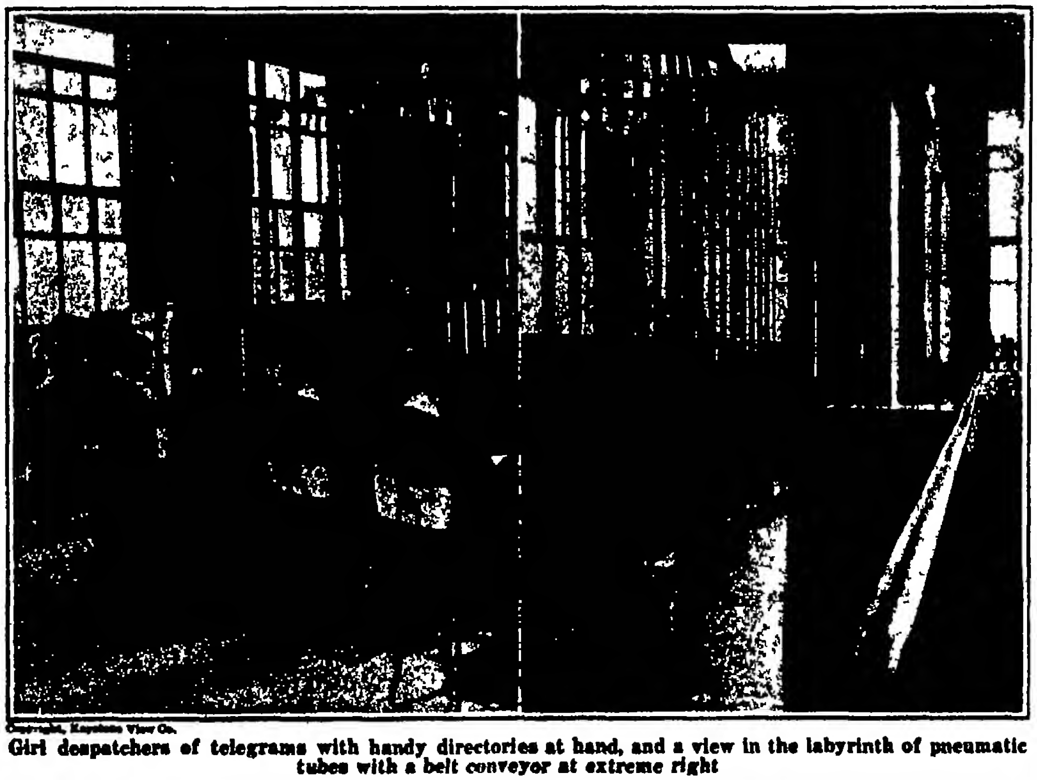
Rapid Transit in the Telegraph Office

SENDING telegrams by compressed air is the latest innovation in American telegraph methods. Greater speed and efficiency and perfect accuracy are the reasons given by the Western Union Telegraph Company for its recent expenditure of millions of dollars in building underground pneumatic tubes radiating from its central operating rooms to its numerous branch offices in the larger cities of the country

One of the most extensive and costly pneumatic tube plants has just been completed by the Western Union in San Francisco, after an outlay of nearly a quarter of a million dollars. Messages handed in by patrons at the branch telegraph offices in that city are no longer telegraphed or telephoned to the main office, but are now enclosed and locked in cylindrical cartridges and deposited in pneumatic tubes, through which they are rushed by compressed air direct to the top floor of the central office, where connection is made with the great network of transcontinental wires. Telegrams coming from all parts of the country to firms in the local branch office districts are dispatched throughout the city in the same manner when received in the main office, a double line of underground tubes being laid to carry messages in both directions.

Many of the tube lines are over a mile in length, and the San Francisco installation is composed of thirteen miles of this copper tubing encased in creosoted wood ducts several feet under the surface of the downtown streets—nearly enough to run a boundary halfway around the city

The accompanying views show the magnitude of the main office terminals of a battery of these tubes. Each line shown in the picture has its other terminus at a distant branch office in some section of the San Francisco business district On the right-hand side of the aisle are the incoming tube lines, from which messages sent in from the branch offices are constantly being discharged into a system of automatic carriers by which they are deposited a few moments later at the telegraph keys and before the operators of the amazing automatic telegraphing typewriters — the multiplex machines, already described in these pages.



Girl despatchers of telegrams with handy directories at hand, and a view in the labyrinth of pneumatic tubes with a belt conveyor at extreme right

The multiplex system, an orderly mass of glass-enclosed instruments, relay switches, whirling brass disks, flashing lights, rapidly clicking typewriters, and reels of perforated tape, sends eight messages simultaneously over a single wire, the typewriters at the receiving end being operated electrically by the sending operators seated at keyboards across the continent. In the San Francisco office the multiplex system carries messages directly to and from the great wire centers of New York, Chicago, St. Louis, Kansas City, Dallas, Denver, Salt Lake, and the important cities of the Pacific Coast. It is stated that 70 per cent of the Western Union's total traffic is handled through these machines either completely or at some stage of its transmission, and the advantages claimed for it, as in the case of pneumatic tubes, are accuracy, speed and efficiency

The central office terminals of the outgoing local tube lines are shown in the second view Here the messages received from hundreds of wires are carried without a moment's delay over the automatic carrier system and shot into the tubes, where they disappear with a sharp hiss of released air to begin their journey through the copper tubes beneath the street traffic of crowded thoroughfares, emerging one or two minutes later at a distant branch office

A Gas-Light Globe That Will Not Crack

EVERY laboratory knows the virtues of vitreous silica ware, which can be heated white-hot and dropped into cold water without breaking But that the same material has uses in the home, the office, and the store is not so well known A series of opal globes, designed for use with the incandescent gas-light has now been placed on the market in England, which will survive the most severe conditions of heat without cracking. Every housewife who has had trouble with the usual glass globe knows how expensive and dangerous the ordinary form is, with its short life and frequent crackings. And the lighting engineer of the gas-lit store or works has hesitated over installing the admittedly superior "indirect" or "semi indirect" system because of the expense and danger of the large opal glass bowls necessary

The new material changes all this. There is absolutely no chance of it cracking through overheating, even if a mantle breaks and the flame impinges direct on the globe or shade For vitreous silica is silica fused in the intense heat of the electric arc (at a temperature of over 400 degrees F) and allowed to cool into the many beautiful and artistic forms in which it is available The great characteristic of this fused silica is that its coefficient of expansion is practically nil From this cause arises its immunity from damage by sharp changes of heat We have seen a piece of this material dipped into water, placed wet in a Bunsen gas flame and heated to bright redness, and then suddenly thrown into cold water No apparent change took place and this drastic treatment may be repeated indefinitely without the "vitreosil" (as it is called) losing its beautiful glaze or its characteristic semi transparency This latter property which bestows upon light transmitted through it a delightful soft effect is due to the presence of innumerable minute air bubbles throughout the whole body of the material The utilization of "vitreosil" for the purpose of gaslight globes and shades is a new departure and it seems to be a successful effort to bring the new discoveries of science out of the laboratory into the home, where they can serve a real practical purpose

A High-Speed Crankless Steam Engine

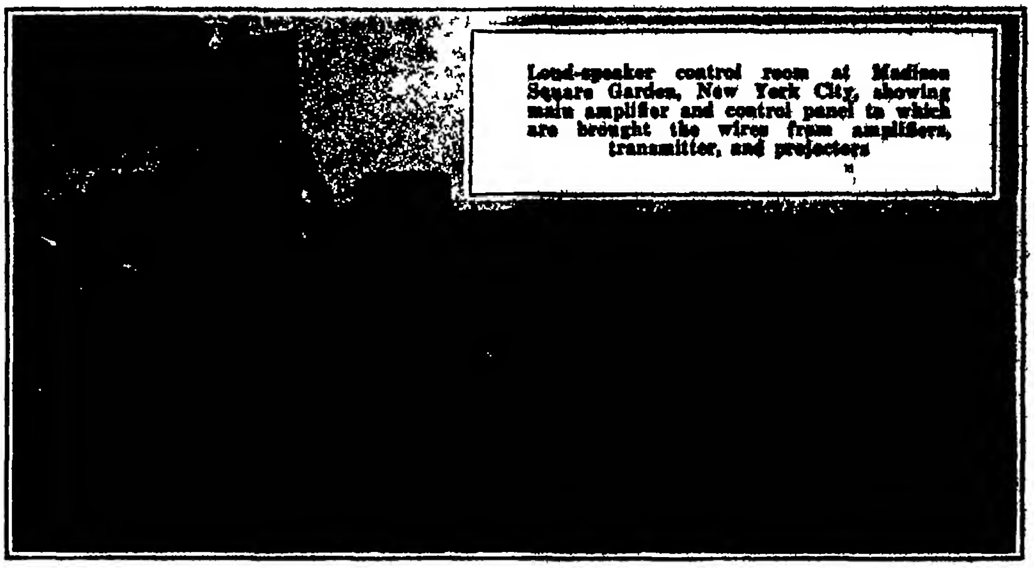
MR. A G M MICHELL, the inventor of the "Michell-block, which has had a world wide success, and has revolutionized practice in high pressure bearings, has recently completed tests of a new type of steam engine There have been many attempts to construct a crankless reciprocating steam engine but none of these has achieved any great measure of success In the latest type, however, advantage has been taken of the new principles upon which the Michell thrust block is founded with every appearance of practical success.

The engine is enclosed in a cylindrical casing, and the rotating shaft is co-axial with this casing The cylinders are in two sets of four arranged round the shaft with their axes parallel to it Instead of crank-shafts there is a swash plate, *i e*, a plate with its plane inclined to the shaft axis, the angle of inclination of the swash-plate in the test engine is 62½ degrees, but in later engines this will be increased to 67½ degrees. As the shaft rotates it will be seen that the surface of the swash plate will alternately approach and recede from each of the cylinders in turn Pistons in the cylinders, bearing upon the plate through spherical bearings and Michell pads, are thereby given a reciprocating motion Opposing pistons are connected rigidly by a bar crossing the outside of the swash plate The engine is uniflow, steam acting on one side of the pistons only It is admitted to the cylinders by two rotating disk valves, one at each end of the casing, and exhausts at the end of the stroke Very perfect balance is assured, and the designed speed of 1200 r.p.m is largely exceeded. The cylinders are 5 inches in diameter, and the engine develops about 90 horsepower at 1200 revolutions. It may be mentioned that the coefficient of friction at the Michell pads, where the pistons bear on the swash-plate, is about 0 002. The whole engine owes its success to this very low value. It may be that an engine of this general design may ultimately be used for aircraft power plant because of low weight.

The Voice With the Nation-Wide Audience

Electrical Equipment Employed in Conveying Arlington Ceremonies to Thousands in New York and San Francisco

By Robert W. King



Loud-speaker control room at Madison Square Garden, New York City, showing main amplifier and control panel to which are brought the wires from amplifiers, transmitter, and projectors

PUBLIC use of loud-speakers has occurred on several occasions recently, notably at the inauguration of President Harding. However, the arrangement used on Armistice Day far exceeded any previous demonstration of the remarkable properties of this latest device for the transmission of speech. On Armistice Day President Harding's address and the prayers and the songs at Arlington were heard as clearly and with as much feeling by 80,000 persons in New York City and 20,000 in San Francisco as though each member of these audiences had been among the specially invited guests within the Arlington Amphitheater. In addition to this at least 100,000 persons scattered on the hillsides outside the Amphitheater also heard the entire ceremony with little difficulty. The combined audience of 150,000 is by far the largest which ever heard a speaker at one time, and the fact that the assemblage was partly on the Eastern Coast and partly on the Western makes the event even more remarkable.

So unheralded was the linking of the three cities in united service and so promising seem the potentialities of the device which achieved this end that the following information is presented not so much for its timeliness as for its bearing on the future.

The success of the equipment used on Armistice Day means, for example, that the President of the United States, if he so desires, without leaving his seat of government, may talk to audiences assembled in every State in the Union, or that the head of an industrial corporation from his office will be able to address, simultaneously, his workers gathered in plants all over the country, likewise college commencement exercises, political speeches, lectures, musical festivals—in fact, all forms of entertainment—can now be transmitted to any number of audiences of almost any size at one and the same time. The influence which this latest triumph of science will exert upon political and industrial activities will certainly be for the better, as it will do much to restore the personal element which ever-increasing numbers and distances have gradually eliminated.

The electrical equipment used on Armistice Day divides itself into two distinct sets of apparatus. First, the apparatus for increasing the volume of speech at Washington, New York and San Francisco, secondly, the apparatus for projecting it out to the large audiences, loud-speakers of the type developed by the Bell Telephone System being installed for the purpose. These loud speakers were joined by a single telephone circuit which extended across the continent as shown in the accompanying schematic diagram. This circuit is likewise a development of the Bell System, and only recently has been perfected and installed.

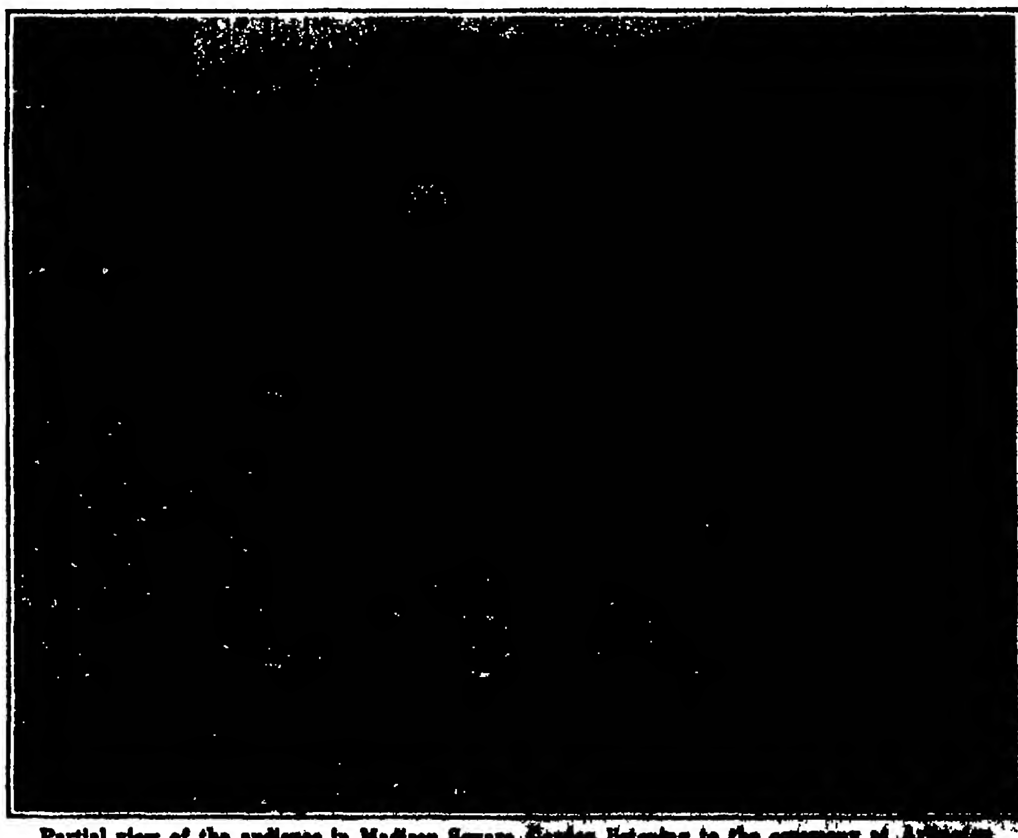
Loud-speaking equipment, to be suitable for important public gatherings, must reproduce speech which is natural and lifelike in all respects. By far the most difficult problems which had to be solved in developing the present loud-speaker equipment were those involving the transmission and reproduction of speech with perfect fidelity, so that all the characteristic inflections and modulations of a speaker's voice, slight though these might be, would be accurately preserved. These problems proved much more difficult to solve than that simply of producing large amplification of the voice. They have, however, been met successfully and the present loud-speaker system is eminently satisfactory both as regards volume and articulation, and so marks a distinct advance in the art of speech transmission. So natural are the sounds of the voice as they come from the loud-speaker, and so very slight is the transition from within earshot of the speaker to the region where only the projectors are heard, that if a person who is standing beside the speaker should walk away, keeping his back turned toward the latter, he could go off 200 feet, or even more, and still have a very distinct impression that the speaker was just behind him.

In many respects the principles underlying the operation of the loud-speaker, and those underlying a long-distance telephone circuit (*e.g.*, the transcontinental circuit used on Armistice Day) are similar. Each usually comprises a transmitter containing loosely packed granules of carbon whose agitation by the air waves created by the voice gives rise to variations of the electric current flowing through them, these variations being an exact copy of these waves; a receiver of the electromagnetic type which converts the variations of the telephone current back into sound waves; and an amplifier for increasing the energy of the telephone current as it comes from the transmitter.

Now in flowing through a long circuit such as the transcontinental line, the telephone current grows steadily weaker as it gets farther from its starting point, and it soon becomes too weak to operate a telephone receiver satisfactorily. Long-distance telephony, therefore, demands some form of amplifier to restore the voice current to its original value. In circuits more than a few hundred miles long, the restoring or amplifying is, for practical reasons, done at regular intervals along the line. These amplifiers are known as telephone repeaters, and their locations in the transcontinental line are shown in the diagram.

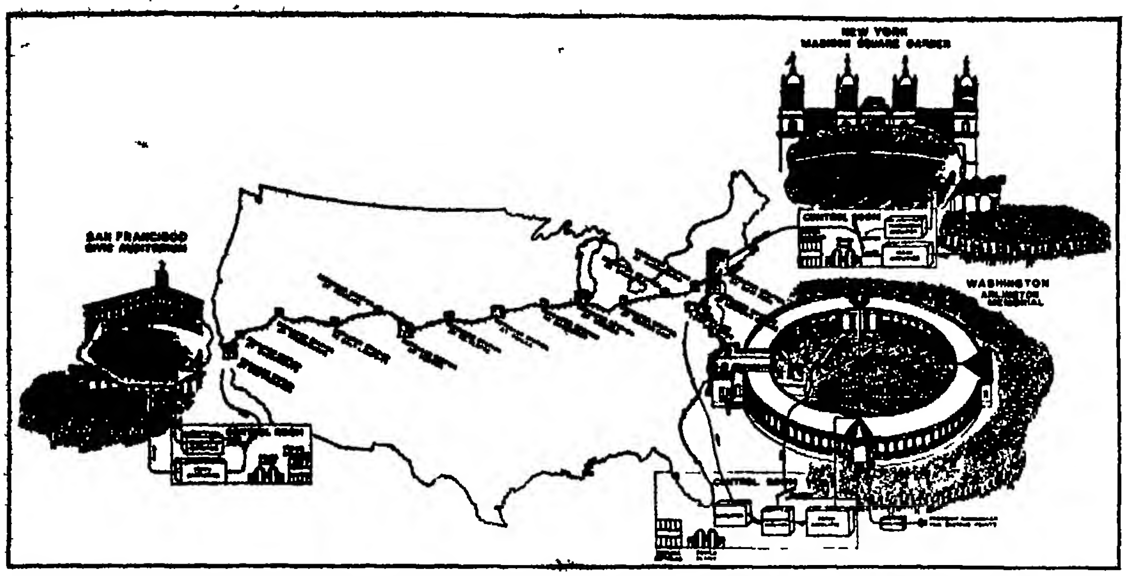
The purpose of the loud-speaker is to magnify speech sounds and project them into the air so that they will reach very large audiences. In connection with the loud-speaker we employ amplifiers, not to restore an attenuated telephone current as it traverses a long circuit, but to magnify the original current as it comes from the transmitter to the order of thousands or even millions of times, and then to reconvert it into very intense sound waves by means of large and powerful receivers. The amplifier of the loud-speaker may receive the small telephone current which it is to magnify directly from a transmitter, as was the case at Arlington, or from a telephone line, as in New York and San Francisco. This point is clearly brought out in the diagram. Through the agency of its amplifier and powerful telephone receivers, the loud-speaker at Arlington gave to the words of President Harding and the other speakers some twenty thousand times as great a volume as that with which the speakers themselves uttered them. The intense sounds generated by the receivers were directed to each audience by clusters of large wooden horns or "projectors" shaped very much like megaphones.

The transmitter of the loud-speaker stands three or four feet in front of and below the person addressing the audience, and consequently receives but a very small fraction of the sound coming from his mouth. Because of this fact and certain others, the electrical amplification involved in the



Partial view of the audience in Madison Square Garden listening to the ceremony at Arlington many hundred miles away

loud-speaker must be truly enormous, requiring such numbers to express it as those with which astronomers delight to startle the imagination. Calculations show that the loud-speaker at Arlington was capable of stepping up the energy of the telephone current coming from its transmitter considerably over one billion fold. The extreme case of amplification, however, was that involved in reproducing the Arlington ceremony at San Francisco. This involved boosting the energy at fifteen repeater stations across the continent as well as initially at Arlington and finally in the loud-speaker at San Francisco. The total amplification within the transcontinental line was over one hundred million million fold. Combining this amplification of the line with that imparted to the telephone current before reaching the line in Arlington and after leaving it at San Francisco, gives the total amplification as about ten trillion trillion fold, or 10,000,000,000,000,000,000,000,000, if one prefers to see it written thus. And it should be borne in mind that this trillion trillion fold amplification was so accurately controlled and applied that the audience at San Francisco heard the speeches and songs as realistically as though they were standing but a few feet from the speaker's stand at Arlington.



Schematic layout of the Arlington installation for catching the voice waves of the speakers, the amplifying and repeating units, the circuit, and the arrangements at New York and San Francisco

The amplifiers of both the loud-speaker and the telephone repeater make use of the three-electrode vacuum tube which is rapidly becoming one of the most important present-day items of electrical apparatus. A vacuum tube amplifier, it should be stated, is not a device which in any sense of the word creates energy For all that modern science knows, the amount of energy in the universe can neither be increased nor diminished Reduced to its simplest terms, the amplifier is simply an electric valve which is so extremely sensitive that by its means one electric current can control with absolute accuracy the flow of another current which may be as much as a million times larger

To bring out this control action of the amplifier more clearly, consider the course of events in the transcontinental circuit as illustrated in our diagram A small undulatory current is generated by the transmitter on the speaker's stand at Washington whenever sound waves strike it. This small current flows only as far as the first amplifier where it brings about the liberation of a much larger undulatory current from a battery associated with this amplifier The variations of these two currents are identical in all respects except that of size. The new and larger current flows to the first repeater station at Newtown Square, in reaching which it has become much smaller than it was originally At this repeater it liberates from a Newtown Square battery a third current—about as large as that which previously started from Arlington—which flows to New York, where the process is again repeated, and so on through the remainder of the fifteen repeater stations extending across the country The final stage of amplification occurs in the amplifier of the San Francisco loud-speaker, in which the current coming from the telephone line causes the liberation of a relatively very large current from the power plant of the loud-speaker. This large current operates the battery of loud-speaking receivers directly While a minute or more may be required to read about the progress of the telephone current across the country as thus set forth, in reality it occurred almost instantaneously, so that the audience in San Francisco actually heard each word sent from Arlington not more than 1/50 second after it had been uttered. To put this another way, it is known that in the improved type of transcontinental circuit the telephone currents travel across the country with practically the speed of light so that a given event in Washington and its reproduction 3500 miles away are virtually simultaneous.

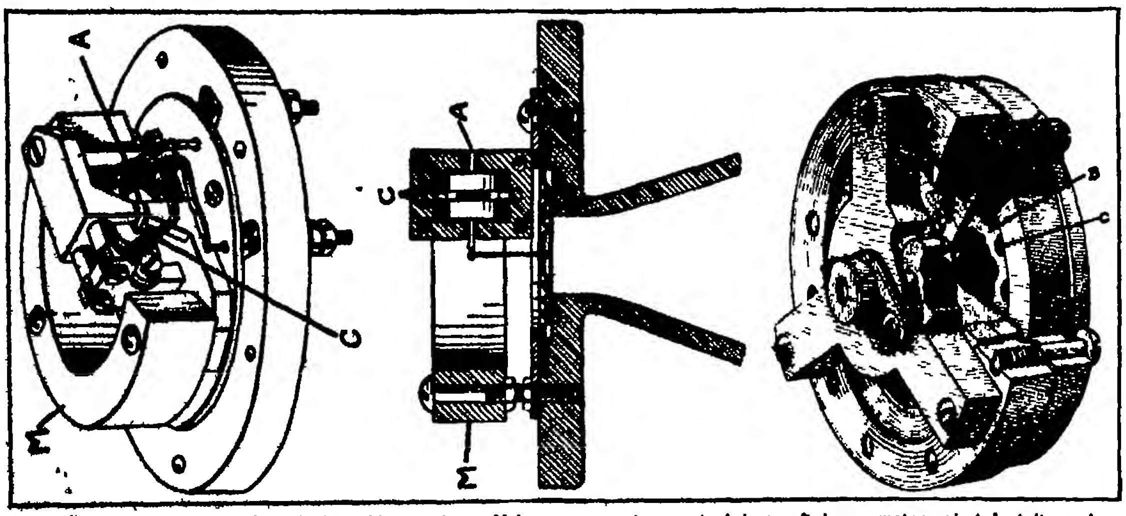
The Utilization of Atomic Forces

THAT the atoms, those smallest bricks of nature, of which chemistry teaches us all material is but a combination, are the seat of unbounded energy one may say has only been discovered by the appearance of radio activity Thus, for instance, it is proved that a very tiny particle of bromide of radium suffices to raise and keep the temperature of its nearest surroundings by several degrees, continually throwing out into space a vast number of electrons, which are very tiny particles charged with electricity This activity continues for about 5000 years till the whole of the salts of radium have been used up. If one takes this fact as a basis of calculation one finds that the energy contained in a single gram of radium would be sufficient to bring 10 million litres of water from zero degrees to the boiling point. Scientists are today of the opinion that radioactivity is not only a property of radium, uranium or thorium atoms, but that it is common to all atoms whatever, only that in other atoms this power is latent If it were possible to start the decomposition of the atoms, which takes place in the case of radium by itself, artificially, the radioactivity must needs also appear

The quantity of energy that could be won by such means is enormous and infinitely greater than that attained by chemical reaction or combustion Up to the present we have produced energy from coal, where the atoms of carbon remained unchanged only combining with the oxygen and forming carbonic acid. If it were possible to break up the atoms of the coals and cause them to spend their latent energy an ocean liner of 50,000 horsepower could travel across the oceans uninterruptedly for ten years using all this time only a single kilogram of coal. Of course the interatomic energy at our disposal today is inadequate, but this does not say that it will always remain so. Perhaps there will come a time when we shall use the energy in the atoms to drive our machines, cook our food and heat our rooms. Besides already today we are actually using even if only a very tiny part—the atomic energy Thus, for instance, the rays emanating from radium are used for therapeutic purposes and the electrons emanating from a glowing filament can be directed so easily that they can be used in a large number of apparatus for wireless telegraphy and telephony Most probably plants also make use of this energy in their growth because it has been demonstrated that the rays of the sun liberate electrons from the green leaves, and lastly it may also be mentioned that we humans also use a little of this interatomic energy when seeing with our eyes, which we are enabled to do by the photoelectric action of light.

A New European Light Electric Car

THE light motor cars that have been brought on the market hitherto are all fitted with combustion engines for liquid fuels. Now there appears a new one with electric propulsion that has many advantages. First of all electricity is at present cheaper than fuel and then it is a fact that can not be gainsaid that the life of tires on an electrically driven car is three times longer than on any other Also there is another advantage the electric car has, in that it is cheaper and simpler to keep up and to run It is not necessary to start the motor by external means. The car starts by simply moving a lever at the driver's side The radius of action of this car is so large that it is in every way suited for town and short distance traffic It can attain a speed of 12 to 18 miles per hour and can surmount slopes of 15 per cent. The battery is in the front part of the car and is large enough, when it is charged fully, to take the car over 48 to 60 miles of even road. The car having been used during the day the accumulator can be recharged during the night from any continuous current main by using a suitable resistance so that in the morning the car will again be ready for use. The accumulator can also be charged from a main with alternating current if a suitable rectifier be used. To recharge the accumulator it is only necessary to connect the pin plug on the switch-board of the car by cable to the charging arrangement. The high price of gasoline in Europe gives the electric car a very definite advantage at present.



The first two diagrams are of the loud-speaking receiver M is a permanent magnet, A is a soft iron armature pivoted at its center C are coils of wire through which flows the telephone current which affects the magnetic properties of the armature The pivoted armature is connected to a corrugated diaphragm, as shown in the second diagram. The third diagram shows the construction of the sensitive microphone or transmitter employed for catching the voice waves. There are two microphone units containing carbon granules, mounted on either side of the diaphragm which is indicated by the unlettered line. B is the face of the transmitter, perforated with holes C. The electrical connections arranged that the distortion of speech which each button tends to introduce is exactly counteracted by the distortion of the other

Two ends of the loud-speaker installation: The loud-speaking receiver and the transmitter

Left: The six blueberry plants at the left of this group spent the winter outdoors and were brought into the greenhouse early in the spring; one month later they had developed as shown in the picture. The plants at the right spent the winter in the greenhouse escaping the natural chilling; and these specimens were still completely dormant when the photograph was staged. *Right:* Two yearling seedlings of the grouseberry which had been similarly treated

Demonstrating the necessity for a period of winter chilling as a prerequisite to the spring growth of plants

How Jack Frost Stimulates Plant Growth

Novel Experiments Which Go to Show That Chilling Governs All Vegetable Growth

By D H Georgian

According to common belief cold weather causes plants to become dormant during the fall, while warm weather the succeeding spring again incites new growth Intensive investigations of Dr Frederick V Coville of the Federal Department of Agriculture, which have been conducted over a period of ten years and which have covered every phase of this subject demonstrate that both of these traditional theories are erroneous. Dormancy in our native trees and shrubs begins some time before the start of cold weather each winter, the appearance of Jack Frost is not necessary for the establishment of complete dormancy Furthermore, after such a condition of dormancy has developed exposure of the plants to the ordinary growing temperature thereafter does not arouse them from their lethargy so that they begin growth anew

Interestingly enough, the Coville experiments show that plants which have responded to the lure of autumnal and winter dormancy will not react properly and resume normal growth the following spring unless they *are subjected during the interim to a period of chilling* A certain amount of cold is essential to stimulate the plant growth—despite the old fashioned idea that retarded growth and low temperatures were synonymous. Dr Coville removed healthy blueberry plants during the late summer from their outdoor beds and placed them in a greenhouse, where the plants were maintained at ordinary growing temperatures such as would have kept the plants in luxuriant growth during the spring and summer months. Despite these ideal environments the refractory blueberry plants refused to continue to grow, but instead shed their leaves and shortly lapsed into a condition of complete dormancy

Subsequently these practical tests were repeated again and again with many different kinds of plants, and without exception all trees or shrubs which were natives of northern, cold climates fell asleep in the late fall and early winter irrespective of the temperature Comparative studies of the susceptibility of indoor and outdoor specimens of the same families of plants indicated that dormancy develops a little more quickly in the plants exposed outside, evidently because their foliage is injured by freezing weather and because they drop their leaves earlier than do the indoor plants. In fact unnatural warmth is a detriment to plant growth inasmuch as trees and shrubs that are kept continuously warm during the winter take up their ordinary growth much later the following spring than their mates which are exposed to a period of chilling and freezing weather

Doctor Coville's detailed tests show that the indoor plants which are not exposed annually to an era of cold weather thereafter will not bloom On the other hand, plants which spent the cold-weather period outdoors burst into leaf and flowered luxuriantly in the spring when they were subjected to proper growing conditions. In the early stages of his investigations this scientist assumed that the plants had to be frozen to stimulate them to growth, but later on more detailed research showed him that the plants required only exposure to prolonged chilling for a period of two or three months at a temperature reasonably close to zero Where this chilling does not occur plants will remain dormant for periods as long as one year under circumstances where the heat, light and moisture environments are ideal for expeditious and robust growth.

The stimulating effect of cold is limited to such portions of the plant as are subjected to chilling For example, a single blueberry plant 44 inches high which had shed its leaves and become dormant in a warm greenhouse where the average temperature was about 65 degrees, was repotted and placed in a position of southern exposure. A small opening was made in the glass of the greenhouse through which one or two of the stems of the plant were projected The opening around the stem was then carefully plugged up with moss. Henceforward throughout the winter part of the plant was exposed to winter weather outside the greenhouse, while the remainder was carefully sheltered and kept warm within the plant residence. The following spring the outdoor branch grew rapidly and luxuriantly while the indoor branch continued dormant Another test of this description was carried out, in this instance the plant being placed on a shelf outside the greenhouse and a single branch passed through the glass wall into the warm interior When the warm weather of spring arrived the branch of the plant inside the greenhouse still remained dormant while the outside branches began to grow

On one occasion Dr Coville made 286 cuttings from dormant outdoor blueberry plants, which he stored in bundles, some in moist moss, others in birch sawdust at a temperature of about one or two degrees below freezing He allowed these cuttings to remain in cold storage for nine months and at the end of that time, except in the case of several cuttings which mildewed and died, one or more buds had begun to swell on every cutting This indicates that growth had begun to occur even at this low cold storage temperature. On another occasion he placed 58 cuttings from dormant outdoor blueberry plants in moist birch sawdust at a commercial cold storage temperature of about 34 degrees. Nine months later buds on every cutting had begun to grow None of the cuttings gave a starch reaction, indicating that their transformation of stored starch into sugar was completed despite their subjection to freezing exposures.

According to Doctor Coville, the establishment of a dormant condition before the advent of freezing weather and the continuation of this dormancy through warm periods in late fall and early winter are protective armors adapted for the use of the native plants and shrubs. The principle of chilling is of the utmost importance to plant growth *If plants were constituted* so that they would start growth readily in the fall under the influence of a few warm days—without the need of several months of chilling—as they do in the spring, many of our plants would begin to grow and burst into bud under the influence of the warm weather of Indian summer and subsequently would be killed by the first heavy freeze But our native trees and shrubs are so intimately adjusted to the changes of climate to which they have been long exposed that they are almost completely protected from injury by freezing On the other hand, cultivated species of plants introduced from sections of the world having a climate radically different from ours are only imperfectly adapted to our climatic changes. These foreign plants attempt to grow at times when our native plants have "learned" that it is desirable to remain dormant, with the result that the majority of such venturesome trees and shrubs are killed.

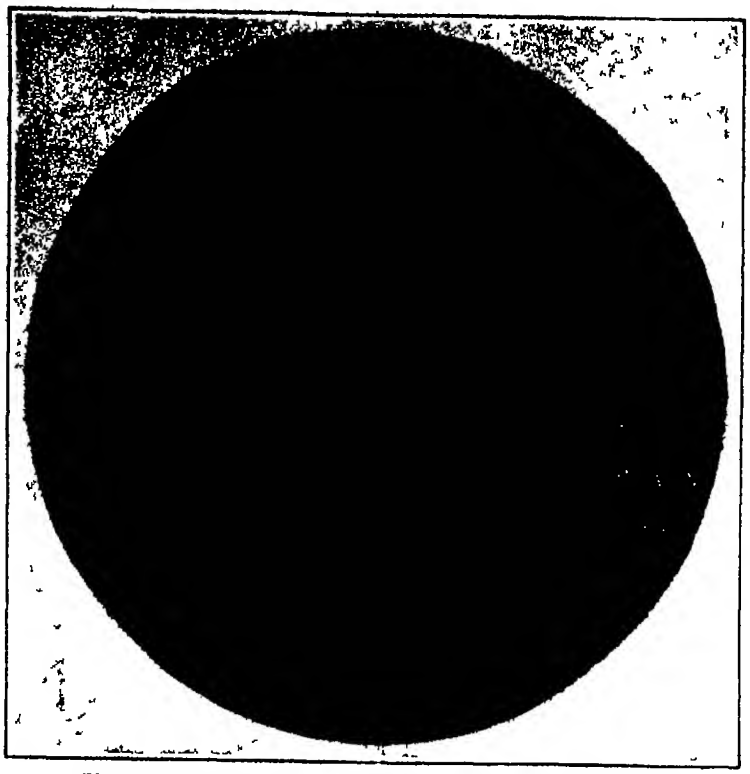
To test out all this, one may during mid autumn bring into the house and place in water freshly cut, dormant and leafless branches of a few early spring blooming plants such as the alder, hazelnut, pussy willow, yellow bush jasmine, Japanese quince, peach or plum They will not bloom Repeat the performance during mid-winter and the branches cut at the later dates will bloom. The period of winter at which these plants will respond in this way depends on the time which they, respectively, require for their annual chilling Thus the period of chilling for the peach in Georgia is so short that sometimes unusually warm weather in December will bring the trees into flower, only to have the fruit destroyed by the winter freezes which always follow But no one ever heard of winter killed violets, their chilling period is winter-long.

Chilling is a necessary event in the annual cycle of the cold-winter trees and shrubs. It is so essential that it limits the geographical distribution of such varieties of plant life. The common northern fruit trees such as apples, pears, peaches and cherries when introduced to tropical countries grow well for a while but ultimately develop dormancy and finally die because they are divorced from the customary chilling for several months a year to which they have long been accustomed. To produce fruit of this description under tropical conditions necessitates the artificial chilling of the plants at stated intervals. Uncle Sam has actually tested out various laboratory contrivances to be used in this artificial chilling.

Doctor Coville suggests that the field of investigation concerning the chilling of plants is still fertile for more comprehensive investigations as he feels that his studies have only lifted the lid which heretofore has concealed scientific facts of immeasurable importance He believes that scientific research should now be directed toward such practical goals as the determination of the proper temperatures for the storage of seeds, bulbs, cuttings and grafting wood; the proper temperatures for the treatment of plants which are to be forced from dormancy to growth at unusual seasons; and proper temperatures for the storage of nursery stock so that the nurserymen may have the plants in proper condition for shipment on any dates satisfactory to the purchasers.

Photographing Blood Stains

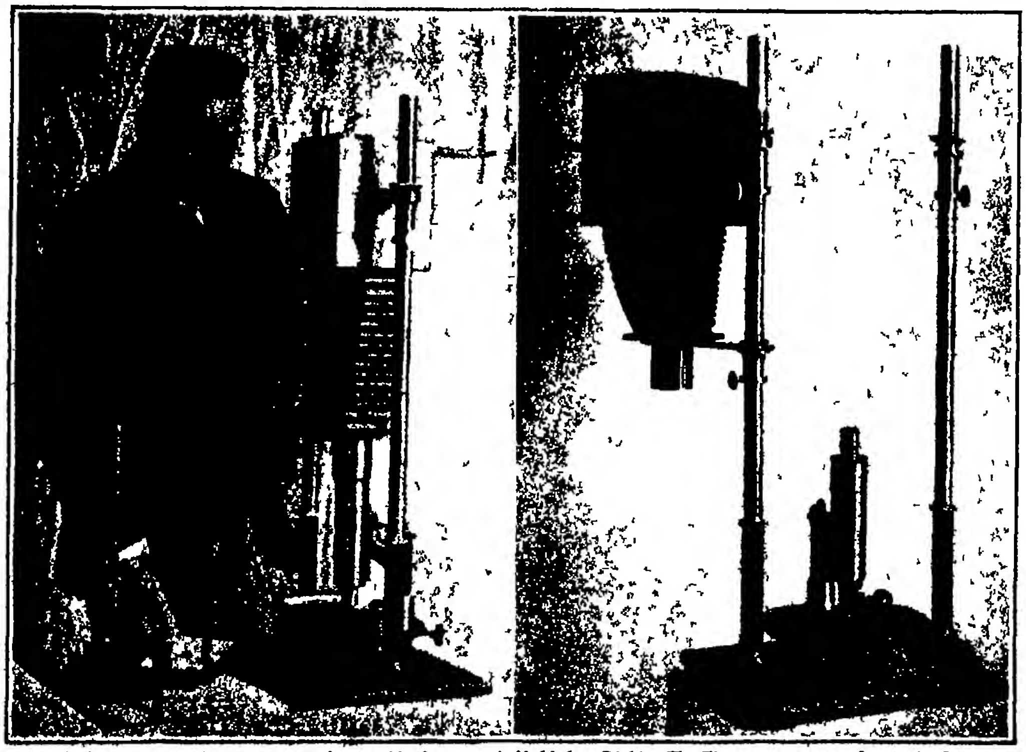
MODERN criminology involves a very close study of bloodstains; and the expert to whom the court assigns this more or less gruesome job has not an easy task. In the first place, it often happens that there is not much blood left on a weapon. If it be a dagger or other sharp instrument much of the blood may have been wiped off on the edges of the wound or on the clothing of the victim In many cases the stain is so faint and indistinct that it is very difficult to get the proper chemical reaction in the process which is usually employed in the close examination of such clues. This new apparatus, of which we show two views, obviates the necessity for the crystallization of the tiny blood globules. The fainter the stains are the better, for those very stains which are the faintest, because of their widely separated globules, are the most desirable for research work The camera is the invention of Dr Florence, a professor at the School of Medicine at Lyons, and it is manufactured by Nachet, of Paris. It merely attempts to record the photograph, or photomicrograph, of the stain, without changing it in any way And such a photograph, of the stain itself, left untouched so that it may be photographed again if necessary, is a far more convincing proof to present to the court than are a few tiny crystals, for example, which are only the products of chemical treatment. Another advantage of this microscopic examination is to show, by the form and size of the globules, whether it is the blood of a human or an animal One of our illustrations is a photomicrograph showing the globules in a drop of human blood, greatly magnified



The normal appearance of human blood under the microscope

This photomicrograph apparatus of Dr Florence is comparatively simple in construction It is made up of three parts the microscope itself, an incandescent gas lamp, and a camera The whole apparatus stands on a wooden base, from which rise two metal columns. Each of these columns consists of two tubes, one sliding within the other, and they may be raised or lowered by loosening the tension of the screws. On one of the columns is swung the camera, a black box for holding plates 9 by 12 inches, provided with a bellows which may also be raised or lowered This camera may be pushed to one side while the object is being studied under the microscope, and then swung into position and fitted over the microscope when the observer is ready to make his photographic record. Between the two columns on the wooden base stands a powerful microscope. The weapon to be examined is placed on a flat platform directly beneath the magnifying lens. To one side is an incandescent gas lamp, fastened to a movable arm, so that it can be placed in the most favorable position. When placed on the base, in front of the microscope, its rays cross the horizontal tube of the apparatus, and by a system of prisms inside are thrown directly on the object. After a close study of the object, the camera is swung into position, and both the box and bellows are raised or lowered to any distance from the object so that it may be magnified and photographed at the desired size.

By this method Dr Florence and other scientists have photographed bloodstains on colored materials. Under such circumstances, the stains are often scarcely visible. The material is treated with an application of a liquid which discolors the fabric itself, but brightens the color of the blood. When viewed under the microscope, even the tiniest trace of blood is sometimes sufficient to be a very important clue in establishing the truth about a crime.—*By C M Lewis*



Left: Making a photomicrograph of a drop of blood from a knife-blade. *Right:* The Florence apparatus for work of this sort

Photomicrographic examination of blood stains, an achievement of modern criminology

Magnetized Scale Weights

RECENTLY erratic and unsatisfactory scale weights designed for use on analytical scales in research laboratories have been submitted to Doctor Pinkowsky of the Federal Bureau of Standards for examination and correction The scales on which these weights were used were useless so far as accurate and authentic weighing was concerned and the scientists using these scales were exercised and anxious to run to earth the cause of error Doctor Pinkowsky found out that the inefficiency and inaccuracy of the scales were due to the delicate weights used which were made of magnetic material In this connection he wishes to warn all scientists and technical experts who have to purchase or use analytic scales and minutely small weights of this description to make certain that such weights are made of non-magnetic material.

The satisfactory weights for use on analytical scales which aggregate one-half a gram or less in weight are made of platinum or gold. Such weights are not subject to magnetization. On the other hand delicate weights of this type made of steel, iron, nickel, nickel alloys or other magnetic materials are liable to be so magnetic as to be practically useless for accurate employment in scientific and research laboratories where foreign factors which exert erroneous influences are undesirable. Once delicate weights of this sort are magnetized it is practically impossible to demagnetize them so that subsequently they may be used commercially Doctor Pinkowsky advises that all scientists or technicians who purpose to purchase scale weights for use on delicate laboratory scales should test out the magnetic properties of these weights before making the purchase in order to insure against buying weights made of magnetic materials which would be worthless for work where the slightest error would be of important concern in governing the success of the results.

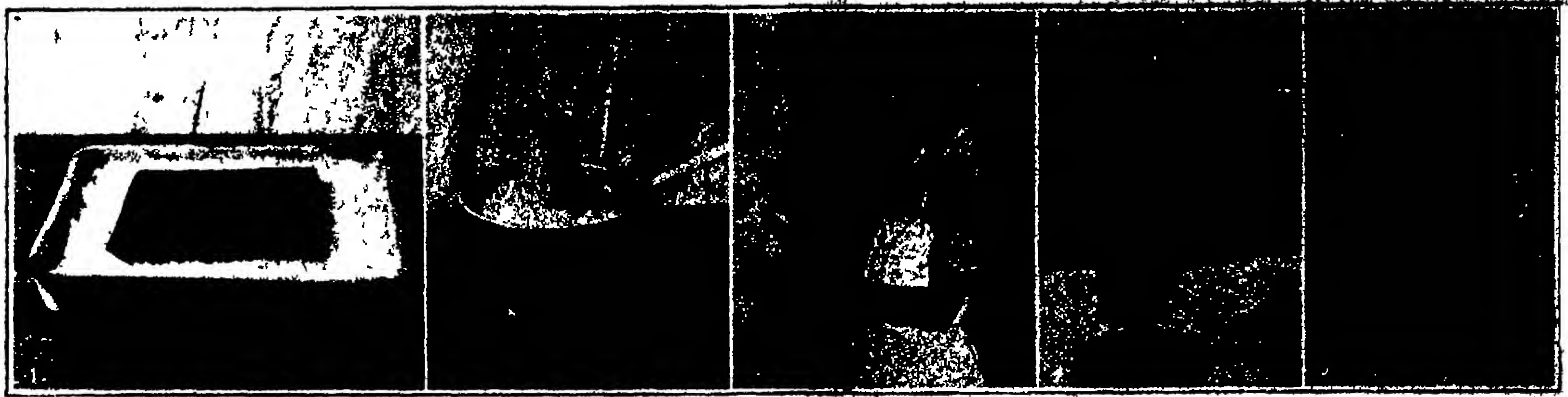
Cocoa and Cacao

THERE is still considerable confusion in the minds of a good many general readers in the north as to whether fruit cocoa and the breakfast cocoa are products of the same tree. In the German Spanish and French languages the correct spelling of the breakfast beverage, *cacao*, has been preserved as it should have been in the English language This confusion arose in England and America, because the a's in the correct name *cacao* have been changed to o's and the final o changed to an a

Coconuts are produced by the coconut palm or *Cocos nucifera*, growing throughout the tropical parts of the world It has no branches, properly so called but the leaves 12 to 14 feet form a kind of crown or fan like summit to the tree beneath which grows a cluster of the fruit or coconuts, which are collected and shipped to northern markets, where they are called coconuts.

The tree has very many uses. The roots are chewed, gutters and posts are made of the trunks the young buds are prepared and eaten in the same way as cabbage the leaves are manufactured into baskets, mattings and many other articles The midribs of the leaves form oars, and the bruised ends may be used in place of brushes the juice of the stem yields palm wine, while the sap produces a sugar If this sugar is mixed with lime it forms a powerful cement. The white meaty part inside the shell of the coconut forms a wholesome food and the milk a cooling drink. The coir or fibrous covering of the hard shell is used for cordage, the shell is used as a drinking cup, and the white meat inside yields the well-known coconut oil of commerce All these uses and many others are attributed to the coconut palm, but it does not give us the breakfast cocoa.

It is the *Theobroma cacao* that yields the cocoa or cacao, as we shall call it The tree is a native of South America but it has been planted also very extensively in all parts of the tropics. The Mexicans call it chocolate, which is one of the names we use The cacao tree is an evergreen and bears fruit and flowers all the year round but the usual times for gathering the fruit are June and December The seeds in the fruit possess the properties which we recognize in cocoa and chocolate as a valuable article of food. The amount of these seeds imported annually now exceeds 150,000,000 pounds.



1 Cooling photographic solutions hypo packed in a large tray cools the solution in the smaller one. 2. Cooling a bottle of milk with hypo. 3. Hot water bottles filled with the hypo are preferable to the ordinary ice-pack 4. This device, with hypo in the can under the conical hood, cools the water as it flows from the faucet. 5. Fruit closets and cupboards may be cooled by allowing the incoming air to pass over an open tray of the cold hypo

Some of the places where the cooling action of ordinary photographer's hypo may be utilized

A New Use for Our Old Friend Hypo

By Frank B. Howe

THE use of common "hypo" (sodium thiosulphate) as a cooling medium, in place of ice or any of the expensive chemical cooling processes, is the innovation of a California chemist who recently disclosed the surprisingly simple and costless process he has devised

It is common knowledge to photographers that hypo, when dissolved in water, causes the temperature of the solution to become very low Starting with this natural property of the cheap chemical, the inventor has adapted this quality to practical use and so harnessed the hypo that it may be substituted for ice for use in the kitchen, in hospitals, in the photographic laboratory, in house ventilation systems, and so on indefinitely through the whole list of places where lowering of temperatures is desired

For cooling milk and other kitchen commodities the bottle of milk is placed in an ordinary kettle, hypo packed around it in the same manner as an ice cream freezer is packed, and the hypo dampened with water The temperature immediately becomes very low and remains so for several hours.

For hospital use the wet hypo is packed in ordinary hot water bottles. Where ice would quickly melt the hypo keeps cool for hours.

Similarly, the hypo method of cooling is used to cool off houses by passing the incoming air over a pan of wet hypo. For cooling drinking water as it comes from the tap, a glass jar of wet hypo, fitted with a conical top, is suspended below the faucet The water passing over this becomes cold in the same way as water passing over ice would do

The use of hypo in this way in no way affects its later use in the usual ways for photography and other purposes. Hypo costs around five cents a pound, hence this method would be cheaper than ice cooling, were the hypo thrown away However, it can either be subsequently used for photography, or else it can be evaporated and used again and again for cooling. In either case, it is not only much cheaper than ice, but a great deal more convenient to handle.

Thus far the possibilities of this medium in the cooling line have been barely touched. There seems to be no limit to its possibilities and possible adaptations. It is simply a matter of taking advantage of the natural property of this chemical and utilizing a medium of cooling that nature has supplied gratis.

Work is now under way upon mechanical apparatus which will permit the use of hypo in great quantities for wholesale and commercial uses of lowering temperature In such cases the advantage over ice would be very great. Likewise in eliminating a great deal of the cost of chemical cooling, as now known, the humble hypo is a great improvement and advantage

However, hypo has its limitations. It will not produce a great drop in temperature, such as is required for many purposes, but it is suitable for many household duties.

Natural and Artificial Sweeteners

AT a recent meeting of the German "Bunsen" Society Professor Theodor Paul, the director of the "German Experiment Station for Foodstuffs," at Munich, gave an interesting address concerning the artificial sweeteners, saccharin and dulcin. Both these substances have the curious property of exhibiting a relative loss in proportion as the degree of concentration increases. In other words, a double amount added to an article of food or drink does not double the degree of sweetness in the latter Prof Paul discovered, however that when combined with sugar either saccharin or dulcin increases the sweetening power in direct proportion, a fact which is all the more remarkable since these compounds have a very different chemical composition from that of sugar It is also true that the degree of sweetness of an aqueous solution containing *both* saccharin and dulcin is approximately equal to the sum of the sweetening power of each constituent. For example, the degree of sweetness of a solution of 280 mg of saccharin in 1 liter of water is so greatly increased by the addition of only 120 mg. of dulcin that the solution tastes as sweet as if it contained 585 mg. of saccharin Here, in fact, the degree of sweetness is almost doubled so that a saving of about 33 per cent is effected This surprising result is explained as follows by a writer in *Die Umschau* (Frankfurt) for October 8, 1921

"Saccharin and dulcin taste much sweeter, comparatively speaking, in low degrees of concentration than in strongly concentrated solutions. On the other hand, the sweetening power of the two is capable of 'addition.' Consequently it is possible by combining the two substances to take advantage of their incomparably higher sweetening power in more dilute solutions. The sweetening power of 280 mg. of saccharin in 1 liter of water corresponds to a 7 per cent solution of sugar; while 120 mg. of dulcin corresponds to 3 per cent sugar solution. Hence when the two are added together they have a combined sweetening power equal to a 10 per cent sugar solution, whereas to attain this same degree separately would require either 585 mg. of saccharin or 1430 mg. of dulcin. Professor Paul calls this mixture of substances 'the pairing of sweeteners.'"

Some amusing tests were made at this meeting of the ability of the distinguished chemists present to detect the nature of the sweetening substance employed. They were offered cups of tea sweetened with one or the other of the three substances, but designated only by numbers. Twenty-one out of 34 persons who tasted tea sweetened with sugar were quite sure that an artificial sweetener had been used. In another test the guests were invited to sip alternately from cups of tea sweetened with sugar and with the combination of saccharin and dulcin, but without knowing which was which. In this case 15 out of 16 persons affirmed that the beverage containing the artificial sweeteners was the most palatable. This experiment was repeated with water instead of tea, and in this instance 28 out of 32 persons declared in favor of the artificial sweeteners without knowing which was which. These results caused considerable merriment, since many of the eminent chemists had previously declared themselves quite capable of distinguishing between the taste of sugar and that of artificial substitutes.

Safety in Farm Power Service

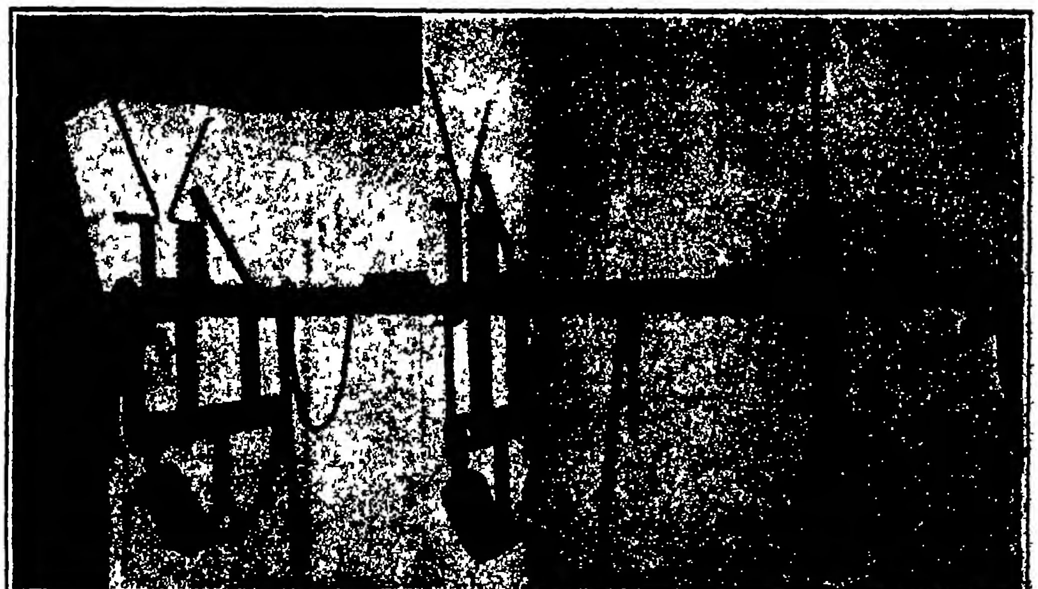
By Allen P. Child

THE increasing demand for electric power on the farm is responsible for the new protective unit recently introduced by a Chicago manufacturer of electrical equipment.

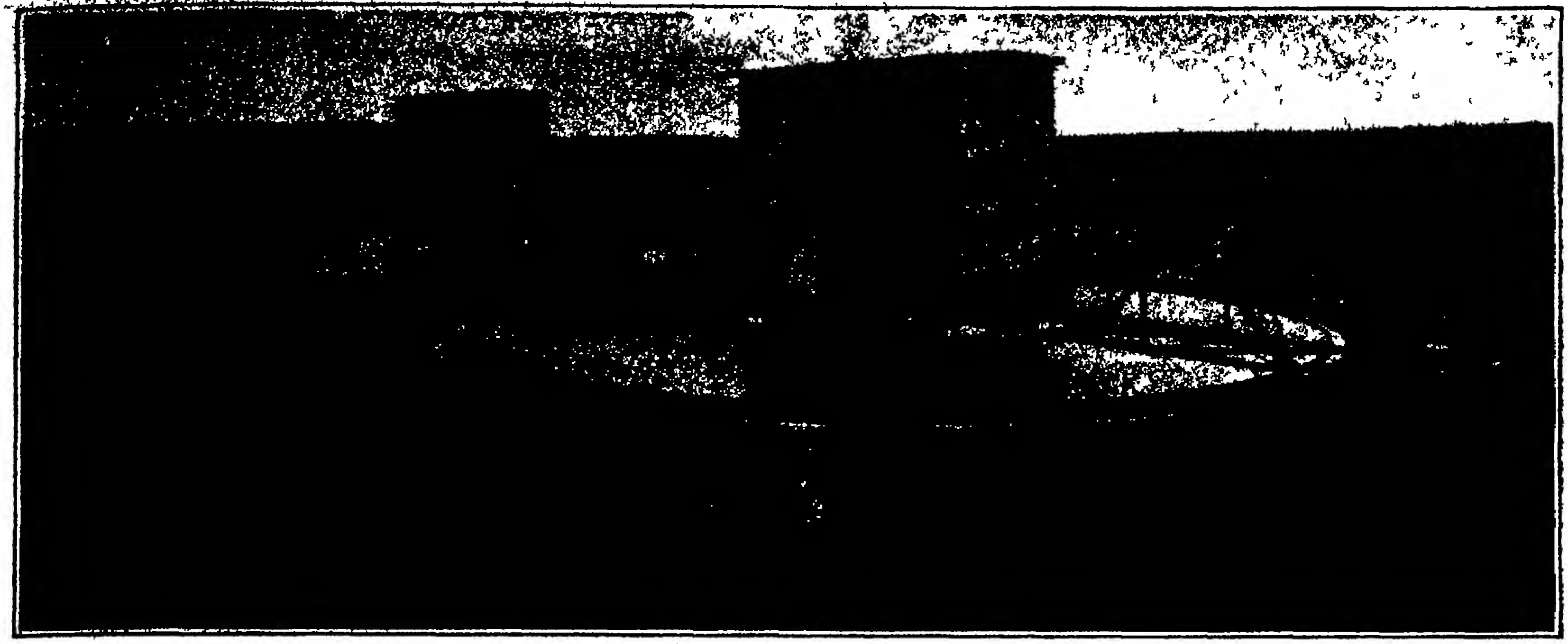
In reality this new unit is a miniature outdoor substation which makes distribution of power to isolated users simple and profitable. This switching and protective combination is furnished for service up to and including 25,000 volts and consists of an adjustable horn gap arrester, disconnecting switch, choke coil and fuse mounting, grouped in one unit.

Units rated at 7500 volts are mounted on one cross-arm, while those rated at 15,000 and 25,000 volts are mounted on two cross-arms. No special structure is necessary as the equipment is light, self-supporting and requires no particular skill for installation.

Corrugated insulators for outdoor installation are one of the novel features of this combination. The corrugations of the insulators supporting the live parts are in all cases vertical. The corrugations of the insulator supporting the grounded arrester horn and resistance are horizontal. The parts supported by this insulator are normally grounded so that this arrangement is possible.



Three-pole protective unit mounted on a galvanized angle-iron support, with rods for operating the switches from the ground



Sewage clarifiers to treat 120,000 gallons per hour

Sewage: The Price of Civilization

One of the Problems of Modern Community Life with Which Our Remote Ancestors Had No Concern

By Harry A Mount

A DECADE ago nearly all American cities simply emptied their sewage into the most convenient body of water But in ten years populations have grown more dense, the use of sanitary appliances producing sewage has increased many times and there has developed a strong public sentiment against disposal of this waste in an unsanitary or obnoxious manner What to do with sewage, therefore, has come to be a municipal problem of first-rate importance

In Europe, where dense populations have made this problem a pertinent one for centuries, only slight progress in the solution had been made, especially in England and Germany, but this experience has been the basis for American experiments. In the past ten years American sanitary engineers have not only kept pace with progress abroad, but have far surpassed foreign developments. Recent experiments would seem to indicate, indeed, that it is not only now possible to remove from the sewage the matter in suspension and solution in a cheap and inoffensive manner, but also the valuable materials known to be present can be salvaged in the form of a valuable commercial product.

Perhaps the first effective method of treatment, which is still in common use, is simply to flow the sewage into large basins, where the solid matter in suspension is allowed to settle and the remaining effluent is drawn off At intervals the basin is drained and the settled sludge is dug out and carried away But this method takes no account of the suspended particles too fine for sedimentation and the great amount of material in solution, and therefore can not be used by communities not near large rivers or other bodies of water.

There are in use at the present time no less than nine methods of sewage disposal, including.

1. Sedimentation.
   a. Straight sedimentation with sludge removal
   b. Imhoff tank sedimentation, with self-contained sludge digestion.
   c. Septic tank sedimentation, with self-contained sludge digestion.
2. Removal of the coarse solids by the use of a mechanically-operated fine screen.
3. Chemical precipitation (followed by sedimentation).
4. Sand filtration.
5. "Sprinkling" or "trickling" aerating filters.
6. Contact beds.
7. Chlorination.
8. Electrolytic oxidation.
9. Activated sludge.

Three of these methods (five, six and seven) are seldom used as complete processes, but usually in combination with one of the others. Electrolytic oxidation perhaps should be regarded as experimental, as it is used only in one small plant Of the remaining methods two stand out as most promising—Imhoff tank digestion and the activated sludge process. Both depend for their effectiveness upon the action of certain bacteria Of these the activated sludge process is newer and has been given much attention recently A long series of experiments has finally resulted in a solution to the most perplexing problem in connection with the activated sludge process, that of what to do with the sludge The chief advantage of the Imhoff tank method is cheaper operating cost, but it is the prediction of some engineers that this advantage can be overcome In such an event there is no doubt that the newer method would very nearly approach an ideal

In the Imhoff tank method the suspended solids are allowed to settle in deep tanks, through which the sewage flows continuously The tank has a sloping bottom so arranged that the sludge passes through slots into a separate sludge chamber Here the ordinary bacteria of putrefaction become active and a digestive action takes place which very greatly reduces the sludge in volume

Primitive sewage disposal in India; a woman standing waist deep in the sludge fills the bucket elevator

This method is open to the criticism that objectionable odors are generated, making it necessary to have the plant in an isolated spot, the expense of installation is very high, and the method takes no account either of the finer solids which will not settle or the material in solution However where large bodies of water are available so that a high degree of dilution can be obtained it is usual to treat the effluent with chlorine to sterilize it and to empty it in this condition. Due to the fact that the bacterial action removes oxygen from the effluent it may be poisonous to fish and other animal life unless greatly diluted

It is usually necessary, therefore, especially in inland cities, to combine with the Imhoff tanks some other method to purify the effluent further before it reaches the streams. Three methods are in common use—contact filters, sand filtration, and aeration by sprinkling over large and carefully prepared filter beds Especially the latter method is effective in producing finally a pure effluent, but in any case a large tract of land is needed in an isolated spot and the installation is expensive But in spite of these drawbacks the Imhoff tank method is perhaps more widely used than any other in this country

A partial explanation lies no doubt in the fact that such public improvements are usually paid for by bonding the community The original size of the bond issue makes little difference to the politician—it is as easy to issue bonds for a million dollars as a hundred thousand. But the matter of operating expense comes under the head of current expense, and if heavy may make excellent election ammunition Therefore an expensive plant which shows a low operating cost is preferred to a cheap plant with a higher operating cost, even though the latter may be ultimately the least costly system. Thus the sanitary engineer is often called upon to meet a political situation as well as a problem in sanitation

The activated sludge process also depends upon a species of bacteria, but operates in an almost opposite manner Instead of working in an inclosed sludge compartment, this species of bacteria is active only in the presence of air and light, and instead of merely causing the sludge to decay they consume it entirely The tiny bodies of the bacteria finally settle to the bottom of the tanks in a brownish jelly like mass and the effluent flows off clear and pure, of a quality almost equal to that of potable water While the water is purified in a single step, the brownish sludge which remains has for some years presented a problem which seemed wellnigh unsolvable

An activated sludge plant consists essentially of machinery for aerating the sewage as it enters the plant

by blowing air bubbles through it, tanks through which the sewage slowly circulates in contact with minute air bubbles for about four hours, and finally some system for removing and denaturing the sludge

There is first developed, under laboratory conditions, a species of bacteria which is introduced into the sewage In order to give the bacteria sufficient oxygen, compressed air is forced through the sewage and then it slowly circulates through the long tanks. At the end of about four hours the bacteria have entirely consumed the organic matter in the sewage and their bodies settle to the bottom. The water flows from the end of the tanks. As fresh sewage enters there is added to it a small quantity of the activated sludge to introduce a supply of bacteria Thus, once started, the bacteriological process is continuous and automatic.

Mechanical self-cleaning sewage screen

The chief expense is that of operating the air compressor, as a very great quantity of compressed air is required. Two schemes are being tried to reduce this cost first, the invention of means to keep the air bubbles in contact with the sewage for a longer time so as to increase their efficiency, and, second, partial separation of the sludge by sedimentation or screening before introducing into the activation tanks.

The most difficult problem in connection with the process, however, has been to find a means of disposing of the jelly like sludge which is a by product. It has been known that the sludge contains the ingredients of a fair grade of fertilizer, being rich in nitrogen in the form of ammoniates. But before the sludge is useful commercially it must be dried and mixed with other fertilizer ingredients Various types of filter presses have been tried for drying sludge with indifferent success, for the physical nature of the sludge makes it almost impossible to reduce the moisture content sufficiently so that it can be handled by ordinary dryers. Centrifugal separators also have been tried, but it has been found that the microscopic organisms which form the sludge are so near the specific gravity of water that they will not separate Air drying is impossible because the sludge, when allowed to stand, rapidly decomposes. It has been the practice in some plants to pump the sludge into an impounding reservoir, from which it is emptied into a stream at high water

The chemical engineer has come to the rescue in this difficulty, and recent tests made by the city of Houston, Texas, have shown conclusively that it is possible to dehydrate the sludge economically and to recover in the process a fertilizer in large quantities. The method tried at Houston was designed by Angus Maclachlan of New York and operated essentially as follows

A powerful sterilizing agent is introduced into the sludge as it is pumped from the settling tanks. The agent used is sulfur dioxide gas produced by burning yellow sulfur in a rotary burner The gas is mixed with live steam in a specially designed mixing device and the gas-steam mixture is passed directly into the sludge tank by means of an inlet pipe in the bottom Bacterial life in the sludge is at once destroyed, and in addition the gas has an electrolytic effect which causes the particles in suspension to coagulate. The mass is transformed in a very short time from its jelly like consistency to a brownish granular mass which can be very easily pressed to a water content of about 75 per cent It can then be dried by the sun or a mechanical dryer to a moisture content of 10 per cent, desirable for shipping The material is then ground and is available for fertilizer manufacture.

Another method of dehydration tried successfully on a small scale but not yet applied commercially consists of mixing a small quantity of sulfuric acid with the sludge and then heating it This has the effect of breaking down the jelly like consistency of the sludge and causing the solids to float. The sludge is then easily skimmed off the top and dried in the regular manner

It is the hope of the inventors of such methods that the sale of fertilizer which is salvaged will make the net cost of the activated sludge process compare favorably with that of other methods. If this end is achieved this process will have the advantage of a low cost of installation, of complete purification of the effluent, of a plant which requires a small space and which generates no offensive odors in operation, and finally of salvaging the useful material from the sewage.

The largest activated sludge plants now in operation in this country are at Houston, Texas. There are two plants, a north side plant, consisting of four units, each with a daily capacity of 2,500 000 gallons, and a south side plant, with two units of the same capacity Each unit is composed of a main aerating channel 280 feet long, 18 feet wide and 9 75 feet deep, ten sedimentation tanks 22 feet deep with a surface area of about 183 square feet each, and a sludge reaeration channel 280 feet long, 9 feet wide and 9 75 feet deep Air is furnished by pressure blowers at 5.25 pounds per square inch, each blower having a capacity of 3200 cubic feet per minute At the north side plant there are three blowers and at the south side plant two. The air is diffused through filtros plates and a total of about 1 44 cubic feet of air per gallon of sewage is used. The cost of operating the north side plant, with an average flow of 6,250,000 gallons per day, per million gallons is Attendance $4 15, miscellaneous $0.85, power at rate of 6-10c per kilowatt hour $5 40, or a total of $10 40, interest and depreciation not included. At the north side plant a dehydration plant is now being erected at a cost of about $80,000, in connection with which the new sulfur dioxide process of dehydration will be used The cost of this plant was about $225,000 and that of the south side plant $115,000. It is roughly estimated by a competent engineer that an Imhoff tank plant of the combined capacity of these two plants would cost about [illegible]. The Houston plants are considered models in economy and efficiency.

Engineers are watching with intense interest for the results which will be obtained in two cities which are applying the activated sludge process on an even grander scale. At Milwaukee a plant is now under construction which will cost about $7,500,000. The city of Chicago is now constructing one large activated sludge plant, one plant which is a combination of the Imhoff tank and activated sludge methods, and another activated sludge plant is planned. These plants will have a capacity about three times as great as the Milwaukee plant. Still another activated sludge plant will take care of the peculiar type of sewage from the packing house district in Chicago.

It must not be imagined, however, that the activated sludge method, or any other, offers a panacea for the problem of sewage disposal. For not only do the requirements of different communities vary, but the character of the sewage itself varies. Usually the kind and degree of treatment required can be determined only after careful analysis. In cities on the ocean or other large bodies of water, as New York City, mechanical screening is often found sufficient, and a large investment in a disposal plant is useless. For this purpose several types of self-cleaning or mechanically cleaned screens have been developed. One of the most successful of these screens consists of a perforated cylindrical drum, mounted on a horizontal shaft, with the drum partly submerged in the raw sewage flow The screened sewage, after passing through the perforations in the drum, flows out a discharge opening at one end of the drum The drum is revolved mechanically, carrying the screenings beneath the drum to a screenings chamber on the other side, while a head of water within the cylinder creates a flushing action that makes the screen self-cleaning

The settling tank, which is often used as a preliminary step for chemical or bacteriological treatment, will also often suffice as a complete treatment The design of the settling tank has been undertaken in a scientific manner and carried very near perfection by American engineers. It is no longer necessary to drain the settling basin to remove the sludge, for the newest forms of settling tank are provided with a means for continuous sludge removal

The most successful type of settling tank is round and comparatively shallow, the sewage being fed in at the center of the tank instead of the edge. This produces an even, slow flow from the center to the circumference of the tank, preventing swift currents or eddies which might pick up the lighter sludge from the bottom and carry it away with the effluent. The incoming stream tends to diffuse over the entire area and the solids settle to the bottom Four arms revolve slowly around the bottom, each carrying a set of "plows" or "sweepers" which slowly push the accumulating sludge toward the center of the tank, from which point it is either flowed away by gravity or is pumped away for disposal. These settling tanks have been built in sizes from 6 feet to 225 feet in diameter.

It will thus be seen that the American sanitary engineer is ready with a sewage disposal system for village or great city. His services are equally valuable to certain industries and in general the same types of apparatus are being successfully applied to wastes from tanneries, glue factories, gelatine factories, beet sugar factories, textile mills, dairy products plants, packing houses, rubber reclaiming plants, dye works and others.

Modern sedimentation tank, showing plows on bottom to collect sludge

The Pneumatic Hub

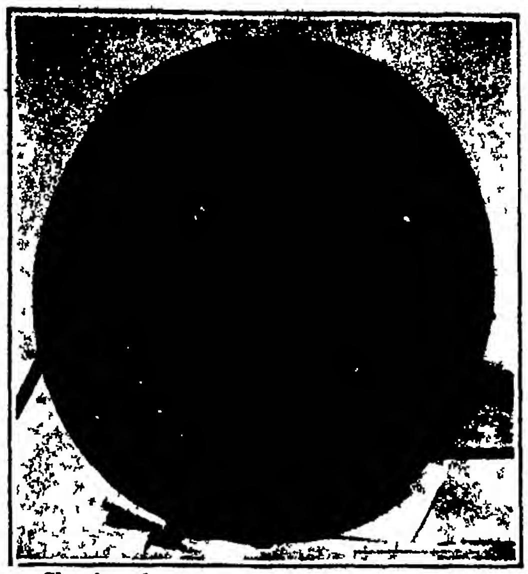
IT is a fact known to every motor-car owner that even the best of springs and the largest wheel profiles are on poor roads unable effectually to damp those heavy shocks and jerks which, especially if acting in a horizontal direction, are bound to exert a most prejudicial effect on the chassis and all parts of the car, particularly the motor.

The pneumatic hub designed by Boris von Loutzkoy and recently shown in Berlin is intended to absorb any shocks acting on those parts which are not spring-suspended. In fact, this hub will separate the drive-shaft from the wheel itself, so that the weight of the rear axle no longer acts on the latter, while any shocks reaching the wheel are absorbed before being able to pass on to the shaft. Inasmuch as the pneumatic hub works in all directions eccentrically to the car axis, it not only deals with vertical shocks, but even with those striking the wheels in a horizontal or tangential direction.

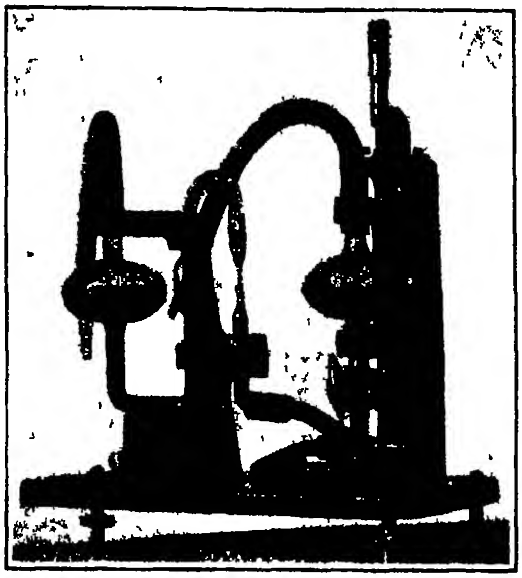
Moreover, it is claimed that the pneumatic hub at the same time insures a remarkable saving of energy and, accordingly, a saving of fuel, that it will accumulate the energy received with every shock, in order, at the following rotation of the wheel, to yield it up again to the motor and the whole plant.

The compressed air which, in the case of the pneumatic hub, serves to insure an efficient spring effect, is produced automatically during the motion of the car, air compressors (cylinders) being arranged radially between the spoke ring and axle bush. On stopping the car these air cylinders are discharged, the axle then lying eccentrically below the wheel centers. As soon as the wheels begin turning the cylinders fill with air. The axle now rests on air cushions throughout and is automatically washed by air. Inasmuch as the air-compressor cranks are under tensile strain, the wheels are automatically adjusted by the weight of the car, the upper cylinders, not working under pressure being by the action of the power plant adjusted to suction. As soon as the cylinders during the rotation of the wheel reach their lowermost position they will compress the drawn-in air. All cylinders work without valves, thus insuring the greatest possible safety of operation.

The cranks also carry along the rear wheels by compressing the air in all cylinders. In fact, the power transmission from the engine to the wheels is purely pneumatic. With any rotation of wheels, especially in the case of braking, as well as with any shock or jerk, there is likewise a compression of air in all cylinders, thus producing by mechanical means a similar condition as in the case of the absorption of shocks by pneumatic tires.—*By Dr Alfred Gradenwitz*



Showing the arrangement of cylinders on the pneumatic hub



Accurate measures of low air-current speeds are made possible by this apparatus

Measuring Low Air Velocities

ONE of the most delicate recording instruments used in scientific work has recently been perfected by F G Wahlen of the Illinois Engineering Experiment Station. In the course of experimental work at the University of Illinois laboratories the problem arose of how to measure low air velocities ranging from 2 to 7 feet per second under conditions where the total quantities of air in motion were relatively large, aggregating between 40,000 and 90,000 cubic feet per hour. In these instances the total head for producing flow was extremely small. It was essential to develop some instrument which would offer no frictional resistance to air flow and which would be extremely sensitive, accurate and readily portable.

After months of effort Mr Wahlen developed such a gage, which is so sensitive that instantaneously it will respond to the most minute fluctuation in pressure. This delicate gage consists of a rigid base set on three leveling screws to support two large glass bulbs which are joined together by an inverted U tube of peculiar shape. The right hand leg of this tube is constricted, while the left hand leg is enlarged at the plane where the liquids meet. The left hand bulb is attached rigidly to the base while the right-hand bulb moves vertically up and down with the carriage to which it is attached. The motion of this carriage is regulated by practically frictionless guides which eliminate all sidesway. The entire movement is controlled by means of a micrometer screw. Pressures are communicated to the two bulbs through flexible connectors on the top of each bulb. The bulbs and the U tube are about half filled with alcohol which is colored red with aniline dye. The upper part of the U tube is filled with clear kerosene and ligroin mixture so that its specific gravity is less than the density of the colored alcohol.

When in use the gage is first balanced at zero with both pressure connections open, care being exercised to adjust the position of the apparatus by operation of the leveling screws so that it is exactly level. After the gage is properly balanced pressure connections are made and the movable carriage and the liquid bulb are so manipulated that the meniscus is brought to the original reference line when a second micrometer reading is taken. The difference between the two micrometer readings when multiplied by the density of alcohol gives the pressure head in inches of water. A final zero reading is then taken to check the initial zero figure. A thousandth of an inch movement of the micrometer screw moves the meniscus 1/16 of an inch.

Because no movement of the measuring liquid occurs, no corrections are necessary on account of capillarity, viscosity, variations in bore of the tube or conditions of the glass surface. The sensitivity of the gage depends on the relation between the areas of the constricted tube and the large cross-section of the bulbs, upon the viscosity characteristics of the two liquids and the small density differential, as well as upon the fact that the constricted portion of the U-tube is very short. This gage is used as a direct reading instrument for measuring and studying the velocities of outflowing air in furnace pipes, ventilators and similar conductors.

Offset Printing on the Pavement

OFFSET printing as applied to the production of the SCIENTIFIC AMERICAN covers was explained to our readers in our November issue, so they are familiar with the general characteristics of the method. We illustrate a curious application of the principle on a much larger scale along the Paris boulevards. A large apparatus identical with the ordinary garden roller, save that the cylinder is of rubber in place of copper, is the means whereby the new trick is accomplished. On the surface of this roller large display advertisements are printed. By means of an ingenious wetting apparatus, as this roller progresses over the pavements the dust of the latter is dampened and a perfect series of printed duplicates of the story on the roller is left behind it. In the case that attracted our photographer's attention the subject of these novel notices was the motion picture play of the hour, but the technique is plainly applicable to almost any topic.

Investigation reveals the fact that this idea is not entirely new. It was shown, in somewhat crude form, in these columns some twenty years ago.

The latest style in perambulating advertisements, fresh from Paris

Forty-eight Speeds

FORTY-EIGHT different speeds—suggestive of a race horse or a touring car—is the variable capacity of a piece of machinery designed and installed at the intermountain experiment station of the United States Bureau of Mines, Salt Lake City, Utah. This unit for injecting chloride—a gas compounded with potash, soda, etc.—together with a rotary kiln, dust chambers, and a precipitator, comprises a miniature plant for the experimental dressing of ores by an evaporation process.

The chloride injector or that part called the screw feeder, is capable of feeding from two and one-half to twenty ounces of chloridizing reagents an hour. Precision demands a positive gear action, rather than mere throttle control, and 48 speeds are called for. This unusual number is made possible by a system of sprocket wheels of different sizes. In the absence of commercial apparatus of the kind desired a scientist of the Bureau of Mines visited a store dealing in second hand bicycles. Here he obtained a series of bicycle sprockets and arranged them into a set of gearing which gives the 48 speeds.

An improvised variable-speed injector with 48 speeds

Left: A prize specimen of the flying fox or fruit bat of Ceylon, and the hunter who has just brought him down. *Right:* A large colony of these creatures, hanging by their toes, head down, in a tree, and giving the impression of large fruit of some description

The fruit bat of Ceylon, individually and en masse

The Bat Pest in Ceylon

THERE are certain creatures from which the average human instinctively shrinks There seems no very good reason why a rat or a mouse should be more terrifying than a squirrel or a chipmunk, but the female of the human species is not swayed by reason in her impulse to seek the high level of a chair seat and make loud noises of terror in the presence of the former animals and not in that of the latter Likewise one of us who can deal most heroically with waterbugs and cockroaches may be reduced to a shuddering mass of inarticulate flesh at mere sight of a spider

For those who are subject to it at all the terror of bats is perhaps as acute as any of these fears. We have even gone to the trouble of inventing a tale to the effect that the bat will get in our hair and can not then be disentangled save by the heroic process of shaving We can imagine that, once thoroughly enmeshed in a lady's hair a bat might have to be shaved loose but why the universal belief that such a fate is his chief aim in life?

All of which is by way of preliminary to the statement that the thousands of objects suspended in the tree of the accompanying photograph are not some strange exotic fruit. They are neither more nor less than one of the vast hordes of fruit-eating bats with which Ceylon is infested. They spend the day hanging in this fashion, head downward—thereby justifying at least one of the traditions connected with the tribe The darker hours they devote to the serious business of raiding the fruit crops.

These bats have made such a nuisance of themselves that the Ceylon government has found it necessary to make a vigorous effort to reduce them, if not actually to exterminate them So official bat hunters have been appointed, who make it their business to combat the flying rodents. The quick and easy method of poison is hardly available, because the fruit which it would be necessary to poison to reach them is intended for human consumption so the campaign is mainly one of shooting The bat's comparative activity during the daylight hours simplifies the issue somewhat.

The particular species involved in this little war is the one commonly known, not as a bat at all, but as "flying fox" That it attains to very respectable size is indicated by the prize specimen of our first picture, which the successful hunter has been at pains to nail neatly to the tree for the camera's benefit The actual body and head, of course, are small, the size lies mainly in the wings. The animal hangs from his forefingers at the upper end of these, with his body suspended, head down, at a considerable distance beneath the limb It is the wing which is then visible, and gives the effect of a large fruit of some sort

Effects of Liming on Soil

DISCUSSING the results of investigations made by himself and many others of the effects of liming on the availability of soil potassium, phosphorus, and sulfur, Mr J K Plummer in the *Journal of the American Society of Agronomy* says More recent research, embodying laboratory extractions with weak solvents, pot studies using a variety of plants as indicators of the concentration of the soil solution in potassium and the analyses of their ash, lysimeter experiments from which the outgo of potassium has been measured, and field tests, have failed to show that basic compounds of calcium and magnesium increase, by chemical action, to any practical extent, the availability of the soil store of native potassium As measured by yields, phosphates of iron and aluminum seem to be as available as calcium phosphates. It is very probably true that fixation of phosphatic fertilizers by colloidal absorption induced by iron and aluminum oxides is responsible for the failure of some crops to respond to phosphorus additions Additions of lime on such soils undoubtedly flocculate some of these colloids, which gives the soil a better physical condition for plant growth

Additions of lime, before or after applications of soluble phosphates, have greatly increased the efficiency of the phosphatic fertilizer When insoluble calcium phosphate has been applied it seems that applications of lime have reduced the effectiveness of the phosphate in the majority of cases.

The scant data of lysimeter experiments only, which deal with the question of sulfate availability or conservation, seem to show that liming, with small amounts of CaO, both small and large amounts of MgO, $MgCO_3$, limestone dolomite, and magnesite, increases the solubility of native soil sulfate. Heavy applications of CaO for a few years at least, apparently reduce this loss of sulfur from the soil.

The Relation of Nutritive Constituents to the Composition of Oat Plants

AS a result of a series of interesting experiments made to determine the relation of certain nutritive elements to the composition of the oat plant, and published in the *American Journal of Botany* for May, 1921 Dr J G Dickson of the University of Wisconsin finds that the calcium content of both grain and straw is reduced to about 10 per cent of that of the plants from the controls by reducing the calcium in the culture solution to one-tenth the quantity present in the complete nutrient solution. It is greatly reduced in both grain and straw by a similar deficiency in phosphorus or in nitrogen.

The total phosphorus content of the grain is reduced to 46 per cent, and of the straw to 10 per cent, of that in the plants from the controls by reducing the phosphate in the culture solution to one-tenth of the quantity present in the complete nutrient solution. It is slightly reduced in both grain and straw by a similar deficiency in potassium, and is increased by a similar reduction of calcium or nitrogen

Although the variations in composition are more pronounced in the straw, yet in general they are similar in both grain and straw.

The phosphorus content of both grain and straw is modified by seasonal differences, except for the plants grown in the phosphorus-deficient solutions. The calcium content of the grain is modified by seasonal differences even in the calcium-deficient solutions. The calcium content of the straw, however, shows no consistent response to climate.

The Vegetable Caterpillar

FUNGI that take possession of the bodies of caterpillars and worms are among the interesting phenomena on the borderland between the vegetable and animal kingdoms. Our illustration shows two excellent specimens of the so-called "vegetable caterpillar" of New Zealand. The larger one measures about three inches in length and the shorter one two inches. The stalks or stems are approximately ten and six inches, respectively

The origin of the vegetable caterpillar, if we are to credit local accounts, seems to have some connection with the rata tree, a parasite of somewhat singular characteristics. The rata seed borne through the air takes root in the fork of its host tree, gradually crushing the life out of it by sending out encircling feelers and finally assuming the shape of a legitimate forest tree. It is under the rata tree that the vegetable caterpillar is found. Its presence is detected by a sharp tail-like spike extending above the surface of the soil.

These were once caterpillars; now they are plants with stalks, the spores having taken possession of the caterpillar's body and fed on his internals

It is said that the (animal) caterpillar feeds upon the rata foliage and ultimately drops to the foot of the tree, where it bores itself into the earth. But the rata spores have entered via its breathing tubes, and soon eat it up all save the outer shell. From the back of the head springs the fungus, terminating in a point covered with the fruit. The viscera, upon investigation, will be found to be entirely displaced by a chalky fungoid substance. The only semblance to the original larva is the outer skin, which maintains all the outlines of its former inhabitant.

This larva fungus is also found in Tibet, as recorded by Dr. A. L. Shelton, for seventeen years medical missionary at Batang, in a recent issue of the National Geographic Magazine. He described the "grass worm," [illegible] for supposed medicinal virtues, [illegible] as we have outlined the vegetable caterpillar of New Zealand.—By George F. [illegible]

The Service of the Chemist

A Department Devoted to Progress in the Field of Applied Chemistry

Conducted by H. E. HOWE, Chemical Engineer

The Fiber Container Industry

MR. J. D. MALCOLMSON, in the August and September numbers of *The Chemical Age* (New York), discusses the fiber container industry and the application of industrial research to some of its problems. The methods employed in studying fibers involved microscopical tests so that various kinds of paper fibers might be identified. This included the perfection of a new stain. All the other laboratory tests, such as certain physical and chemical ones, proved to be informing, but so far as the consumer is concerned the ability of the materials to withstand freight handling and the ordinary usages to which containers are put is of more direct importance. A new test known as the Webb test has been developed, with which each side of the corrugated board may be tested separately. A drum box tester was constructed with a set of scientifically placed baffles which compel the loaded box under test to drop on each side and corner, thus duplicating the average treatment in use. In this drum more than 1900 fiber boxes of all varieties with different loads have been tested and results have enabled specifications to be based on facts.

Optical Method for Oil Analysis

THE July issue of the *Cotton Oil Press* describes an optical method for determining oil in all oil-mill materials. The method consists of grinding in a warm mortar two grams of a sample containing a known oil with three of Halowax oil. A portion of the liquid is then removed by drawing it through a plug of cotton in a tube and the refractive index of the mixture is determined. This operation requires about eight or ten minutes. The percentage of oil is obtained by reference to a table or chart prepared from readings of mixtures of known proportions of the solvent and the oil in question.

The accuracy of the test has been demonstrated by comparing results with those obtained by the extraction method and the difference was found to be but one point in the second decimal place. This rapid method should make possible the purchase of oil-bearing materials on the basis of their oil content, which has not been the practice in general heretofore. Besides this the superintendent of a crushing plant can have frequent analyses made of his various products, can know how efficiently his machinery is operating, and can be aided in establishing a certain control over operations.

Pink Cottons

IT is not unusual to have bleached cottons assume a pink coloring either at the bleachery or shortly after being removed. A short time ago a merchandising house began to send complaints from various departments to the laboratory appealing for information both as to the cause and the cure of pinkness in case after case of cottons drawn from the warehouse. The first troubles were referred to the bleacheries, but when materials of all kinds were found colored it became evident that the trouble lay in the [illegible]. Remembering that white [illegible] often turn pink when aniline [illegible] in curing the rubber [illegible] was made of all cases [illegible] of rubber [illegible] found to be affected.

This is but another example of the great influence of small quantities of some compounds. About three ounces of aniline oil were used in each 70 pounds of the rubber compound which caused this trouble, and the injured goods were wrapped, boxed and packed in approved fashion. Some believe that the pink color occurs when aniline comes into contact with hydrocellulose formed when overbleaching occurs. Others argue that the color is most pronounced when furfural is present, and this compound is likely to be found in small amounts wherever starch is used, as in finishing dry goods.

Various methods for removing the color have been proposed, all being aimed at bringing about a change without actual refinishing. This suggests the use of gases in a way to form minute quantities of fixed alkali in the goods. Unfortunately it is difficult to convince the public that the coloration under discussion is not injurious to the goods and will disappear with the first washing.

Lithopone

IN the August number of *Chemical Age* there is printed a short article on lithopone which serves to remind us how important this pigment has become. More than 85,000 tons of barytes were used for the manufacture of lithopone in 1918 as contrasted with less than 45,000 tons in 1915. The process of manufacture consists in bringing together barium sulfide in solution with purified zinc sulfate, heating and mixing with the result that an insoluble precipitate is formed consisting of 68 to 70 per cent barium sulfate and 30 to 32 per cent of zinc sulfide. This precipitate is dried then heated red hot and quenched. This is the delicate part of the process, changing the constitution of the powder and making it opaque and white. Finally it is ground in water and floated. During heating some of the zinc sulfide is changed to oxide so that 1 to 10 per cent of the final product is zinc oxide.

Lithopone is whiter than white lead and equal to the best grade of zinc oxide. It is not affected by sulfur or hydrogen sulfide, is not poisonous and does not blacken by combining with lead contained in pigments or driers.

Beet Molasses

H. W. DAHLBERG in discussing the chemical problems of the beet sugar industry in *Chemical and Metallurgical Engineering* points to the possibilities in the by-products from the molasses which are not suited for human food. The ash in molasses contains nearly 50 per cent of potash as K_2O which may be recovered by evaporating the waste matter from the Steffens process, where the sugar is recovered as saccharate, and burning the thick liquor, leaving the ash, which may be used as a fertilizer or worked up into potassium carbonate. The vegetable carbon is useful as a decolorizer. This simple process takes no account of the nitrogen, present in the waste water, which should yield methylamines, cyanide and ammonia. Attracted by the demand for dimethylamine as a vulcanizing accelerator, research is in progress to determine the best ways to secure high yields and pure products of this class from molasses.

The author considers the following as possible molasses by-products: sugar, potassium carbonate and sulfate, sodium carbonate, carbon, methylamines, sodium cyanide, ammonium sulfate, methyl alcohol and vegetable tar.

Fixed Nitrogen

AMONG the methods of fixing atmospheric nitrogen is the one which depends on the conversion of alumina into aluminum nitride and a patent has been issued to Mark Shoeld on an improved technique. The calculated quantity of carbon and finely ground alumina is made into briquettes which are then mixed with larger pieces of coke. This mixture is fed continuously through an electric furnace equipped with stationary electrodes. Producer gas, providing the nitrogen, is admitted through inlets. The larger pieces of coke carry most of the current serving to produce the temperature for the reaction and at the same time prevent the fusion together of the briquettes which are later separated from the coke by screening. The coke is used repeatedly until worn to a size too small to facilitate separation from the briquettes.

A Shell Game

POULTRY requires charcoal in various sized pieces as a part of the ration, and it has been customary to use willow charcoal for the purpose. Many tons of this commodity are sent into southern California yearly where the disposition of walnut shells has been a problem. It has remained for the chemical engineer to convert the shells into the charcoal for which there is the demand. The manufacturing plant is simple, consisting of a 10-inch by 10-inch rotary kiln into which the ground shells are fed through flame into a hot zone where the dust is burned away. The kiln is fitted with baffles and lifters to secure proper mixing, which is essential to uniform charring. Tar is distilled off and the charcoal quenched as it leaves the kiln, is screened into four six and ten mesh sizes before sacking. It is of excellent quality for poultry, more gas absorbent than willow charcoal, and dust-free. One ton is produced for each three tons of shells. Creosote oil and pitch can be made from the tar recovered from the flue gases. The venture is very profitable.

Experiments are now under way with fruit pits, shavings, etc., and it may be that the process will offer a simple solution in the case of other wastes.

Iron Tanning

THE Journal of the American Leather Chemists' Association abstracts an article by G. Grasser on the chemical control of iron tanning.

"The use of iron salts for tanning has increased to such an extent that manufacturers have begun to prepare iron tanning extracts on a commercial scale. The leather chemist is now called upon to establish methods for controlling the iron liquors as well as for analyzing the extracts and leather. It is important to regulate the concentration of both ferrous and ferric iron in the liquors during tanning. Iron tannages may be readily detected by moistening a cutting with a solution of acetic acid and tannin, which changes the color from a brownish red to a bluish black. The leather may be analyzed by methods commonly used for chrome leather, the important determinations being water, ash, ferric oxide, calcium oxide total acid, sulfuric acid, fat and hide substance. The ferric oxide content of seven leathers examined varied from 9 to 37 parts per hundred of hide substance."

Unburnable Balloon Gas

THE work under direction of the U. S. Bureau of Mines on helium production has attracted much attention because we must have unburnable gas for dirigibles if balloon navigation is to have a satisfactory degree of safety. But helium at best is expensive and may not be available in sufficient quantity so that a gas mixture is desirable. It has now been found that 18 to 20 per cent of hydrogen may be mixed with helium and still produce a mixture which will not burn with a persistent flame when flowing from an opening under conditions similar to those present in balloons. When the percentage of hydrogen passes 14 the gas mixture can be ignited under favorable conditions, but combustion is not supported.

Preserving Mine Timbers

GREAT quantities of mine timbers are being placed in American mines without preservative treatment, notwithstanding the fact that 10 years is about the average length of life of such wood in service. In one experiment 80 per cent of the treated timbers were still sound after such length of service and none needed replacement. A note from the Forest Products Laboratory says:

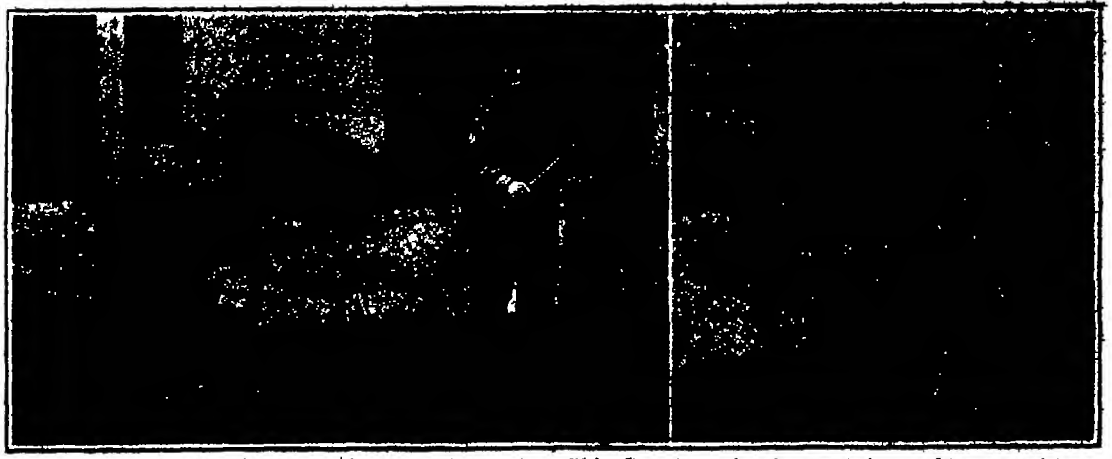
"At least three preservatives have been found suitable for mine work. These are coal tar creosote, zinc chloride and sodium fluoride. Creosote is the most effective in preventing decay. Timbers thoroughly impregnated with it are likely to resist decay until they are crushed or worn out. Occasional objection is made to the possible fire hazard of creosoted wood, but long experience indicates that the additional fire risk is very small. Zinc chloride and sodium fluoride are odorless, and if anything they tend to reduce the inflammability of wood. They are cheaper than creosote, and although they do not give such permanent protection they greatly increase the life of timbers. Coal-tar creosote may be applied by the brush, dipping, open-tank or pressure methods. Zinc chloride and sodium fluoride may be injected by the steeping, open tank, or pressure methods. The cost and effectiveness of the methods of treatment increase in the order given. The saving possible with any of them is so great that it will pay every mine to adopt the use of some preservative on permanently located timbers."

Artificial Stone

A BRITISH patent for a new artificial stone specifies nearly equal parts of porcelain or faience refuse, powdered pipe clay and crushed glass as suitable materials. These are mixed with water and placed in a mold, the bottom of which is covered with the glass. Pressure is applied and the mixture then heated to 900 or 1200 degrees. The result is an artificial stone, marble-like and with a glazed surface. Various colors are easily possible.

The Street-Cleaning Buggy

MOST of us have seen the street cleaner traveling back and forth through the street with his long handled brush and his shovel, and his little wheeled cart into which he shovels his accumulation of filth or perhaps he will have been pushing before him a scraper with broad flat blade and guard at the back, taking the place of broom and shovel. This is an improvement over the simpler scheme, but it still makes it necessary for the white-wing to dispose of the loaded scoop by emptying it into a cart of some sort, and this in turn makes it certain that he will lose a lot of time in handling the cart.



Left: With the flap side down, in position to take the sweepings. *Right:* Turned over the other way to be moved to a new point

The street-cleaning buggy that reduces sweeping and shoveling to a single operation

San Francisco has just installed a "street-cleaning buggy." At first glance this device might seem to be a step backward, since it returns to the old broom, which obviously can not itself make final disposition of the material it sweeps. But the trick is not in the broom at all, it is in the construction of the cart. As is so often the case, this is merely a metal barrel slung between wheels but it has a wide, flat lip which swings with the long handle, while the barrel itself remains fixed on the axle. The sweeper wheels this contraption to the proper point and then throws it over its own head into the position shown in our first view He sweeps directly into it, via the flat lip, and when he is ready to move he throws the lip and the handle back over the barrel This discharges the results of the sweeping into the barrel, and restores the whole apparatus to the appearance and the function of an ordinary two-wheeled cart, which he then trundles to the next point of attack Sweeping and shoveling are thus reduced to a single operation, and much time saved The device can of course, be used only on asphalt or comparably smooth pavements, but this does not seriously restrict its application in our largest cities.

The One-Piece Living-Room Suite

DOUBTLESS it is the small modern apartment which is responsible for the vogue of the combination phonograph, step-ladder and bathtub, or its first cousin that can be converted from an ornamental lamp-stand into a highchair for the baby, and from that into a clothes drier, by a twist of the wrist But ridiculous as some of the combinations actually offered are, there is really a germ of utility in them, for if we have room in the apartment-ette for only a single piece of furniture, it really is rather essential that this piece be made to serve several ends.

We illustrate a rather ingeipous member of this combination family from France. As it stands it is not difficult to realize that the foot of this rather elegant bedstead can be capsized into the head to give us a highly ornamental side board. And we have then the photographer's word for it that if we turn it about and put its face to the wall it will show us, not a back but another face which shall be nothing less than a book case. We suspect that what he means is that the upper half swivels about and reveals a half length bookcase, we have our doubts that there is room in the bottom of the apparatus for the mattress and for rows of books in addition, even if the mistress of the house were to find it entirely convenient to turn it about from the floor up. And even so, it seems fairly clear that there will be no accommodations here for Webster's Unabridged, or any volume approaching it in depth Still, there must be some drawbacks about living in a one-room apartment, and doubtless some compensating advantages. This bedstead-plus surely makes the most of the latter

A bed or a sideboard at pleasure from the side shown, and a book-case by turning it around

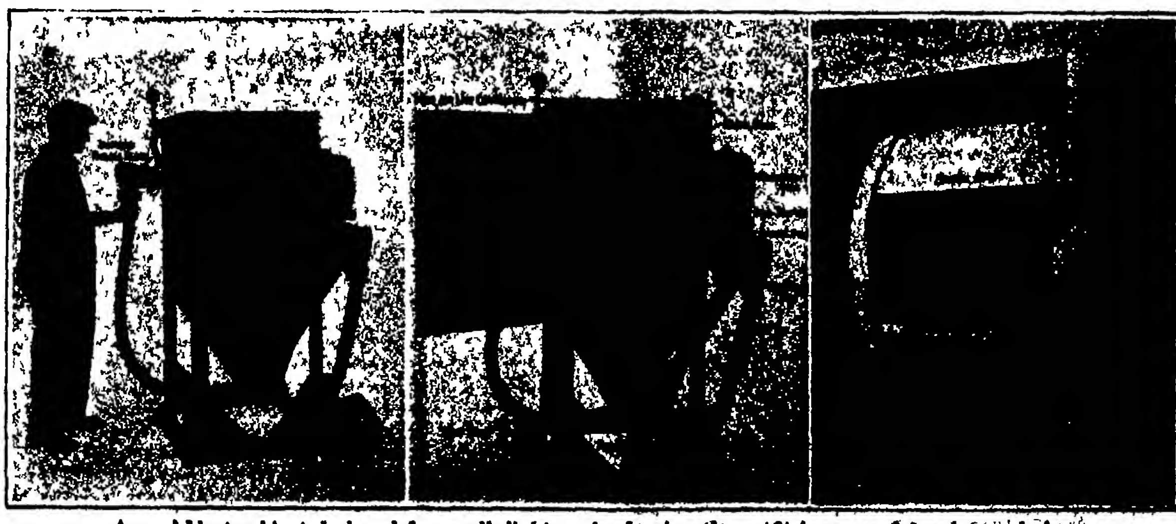
Lichens That Eat Church Windows

THE deterioration which sometimes takes place in church windows is due, in many cases, strange as it may seem, to the growth of lichens upon the glass. No less than 19 species of these lowly plant forms, which consist of an alga and a fungus mutually interdependent, have been identified as making their habitat upon the glass of church windows, and they seem to thrive upon this sort of artificial rock to such an extent as actually to injure the glass. A French woman, Mlle. E. Mellor, who has been studying this curious phenomenon, has made a report upon the subject, which is published in the records of the French Society of Biology, for April 16, 1921. She states that while it is usually the exterior surface of the glass which is attacked, the lichens sometimes develop, at the same time, upon the interior surface. Her observations have led her to conclude that the roughening or "eating" of the surface of the panes of glass is directly due to the carbon dioxide set free by the lichens.

Sand-Blasting Small Parts

ONE of the mechanical facilities offered the modern technical world which has not been taken advantage of to the apparent full extent of its possibilities is the sand-blast It ought to be sufficiently evident that much time could be saved in many grinding operations, and even sometimes in light machining, if equipment were to be had for the suitable sand-blasting of small parts as a preliminary to these operations. It seems as though in nearly every industry the sand-blast might find a wider range of use if apparatus were available which should at once be practical and efficient and small enough to handle economically the numerous small parts that are being continually ground, machined, heat-treated, galvanized or otherwise worked.

It has in the past been only too true that sand-blasting machinery was for the most part too expensive in first cost, too bulky and too costly in operation to do such work. An effort to meet this need is now being made, however, by a Hagerstown, Md., manufacturer, who has put out the small and compact unit illustrated herewith The device consists of a sheet-metal dust-tight cabinet on a structural frame, the bottom being hopper-shaped to receive the abrasive, and equipped with a feed-fox to which is attached a hose that conveys the sand to the nozzle. The barrel drum mounted within this cabinet is 24 inches in diameter by 16 inches long, of perforated sheet-metal, The shaft on which it runs is geared in reduction by worm to the main driving shaft, which in turn is equipped with tight and loose pulleys and belt connections. The interior of the barrel is fitted with baffles, which turn the load as it rotates slowly, bringing all pieces and all faces under the blast action. The spent abrasive drops through the perforations of the drum. The whole outfit seems a model of compact business, and should be an addition to any machine shop.



A sand-blast cabinet designed for small, light work, showing the outfit in use and two internal views of its construction

The Motor-Driven Commercial Vehicle

Conducted by MAJOR VICTOR W. PAGE, M. S. A. E.

This department is devoted to the interests of present and prospective owners of motor trucks and delivery wagons The editor will endeavor to answer any question relating to mechanical features, operation and management of commercial motor vehicles

A 750-Gallon Tank Plus a Motor Truck for Transporting Ink

THE desirability of shipping in bulk and eliminating the use of small containers has long been recognized. However, transporting ink in a 750-gallon tank would hardly seem feasible to those of us who consider a pint bottle of this commodity a large quantity Nevertheless, an ink manufacturer of Hoboken is using a large tank-truck of this capacity to supply New York newspapers.

In a modern newspaper building ink is stored in a tank near the roof. This tank is connected with the presses by means of pipe lines. The ink manufacturer's truck delivers ink in bulk, attaching a hose to the filler pipe outside of the building. Through this pipe the ink is rapidly pumped up to the storage tank

When the sales engineers of the motor truck company first considered transporting ink in bulk, they were forced to find some method of preventing the ink's congealing in cold weather. This difficulty was satisfactorily overcome by passing the exhaust pipe of the engine through the tank

Scoop Body for Motor Trucks Has Many Advantages

IN the building of highways and the transportation of building materials, a scoop body for motor cars to facilitate work and lessen the pay roll was recently invented.

The device is a simple all-steel self-dumping body specially designed for small motor trucks and can be attached to the chassis or detached in a few minutes by means of four bolts. The scoop is so constructed that it can be used as a single or double unit, as shown in the accompanying illustrations. The body is self- or gravity-dumping in operation

It is particularly adopted for hand loading and dumps itself when a latch for this purpose is tripped, rights itself by means of springs after it has deposited its load and then locks automatically The dumping and righting is accomplished without the necessity of the driver leaving his seat. The scoop is built low to meet all requirements of the overhead hopper

By reason of a steep angle of dump tail end, the discharge is clean and shoveling out the dregs is never necessary The final shock of the dump, which clears the body, is sufficiently cushioned by the spring in the check chain to prevent damage to chassis or body The body itself is made of ⅛ inch steel plate throughout, with smooth rolled and welded steel reinforcing flanges around the top. The bottom is also heavily reinforced by angles. The whole device is built for long durability

This truck carries furniture between Boston and Philadelphia, New York and Washington

Farmers a Potential Truck Market

AGRICULTURE is the most important activity that human endeavor has, but it receives the least attention, so far as transportation goes. When conditions become normal again and the farmer is not handicapped as he is at present by having to sell his produce at low cost and pay high prices for the commodities he needs, there will be an enormous market created for motor trucks in the agricultural industry, just as there is now in manufacturing industries.

Census figures show that the total number of farms in the United States is 6,361,502, of an average size of 140 acres. It has been stated that any farm of 80 or more acres can use a motor truck profitably Adding a factor of safety of 75 per centum to this estimate, it is concluded that a farm of 140 acres can economically support a motor truck It is, therefore, reasonable to assume that if every 140 acres of farm land will support a motor truck, the possible number of motor trucks that may be sold is 6,361,502 To be conservative, suppose that only one-third of this number would be motor truck prospects, we thus find a potential market for 2,120,500 motor trucks Comparing this number with the number already in use, we find that only 3.2 per centum of the potential market has been sold on the actual use of the motor truck

Several novel features, aside from the multiple-unit dump body, distinguish this new dump truck

The fact that motor truck hauls during a certain period from farms to shipping points averaged 11.3 miles, while horse and wagon hauls averaged 9 miles, and that the motor truck made 3.4 round trips over the longer route, while horses made 1.2 round trips over the shorter, is evidence enough that the motor truck is needed on the farm In the bargain, truck hauling of wheat costs 15 cents per ton-mile, against 30 cents by horses, with even more favorable figures for cotton.

Truck Carries Complete Furnishings for Six-Room House

AN organization of furniture packers and movers of Boston recently placed in service a motor truck that is unquestionably one of the finest vehicles devoted to furniture hauling in America This de luxe moving van consists of a special enclosed body mounted on a 3-3½-ton White chassis. The truck is used almost exclusively for long hauls between Boston and Philadelphia, New York, Washington, Baltimore and other points. It is fitted with sleeping quarters for three men This enables one man to drive while others sleep and keeps the truck on the road day and night

The body is constructed without the interior padding common to furniture trucks. Removable boards divide the storage space into compartments, with provisions for tying the load through apertures in the bottom of the body The driver's compartment, which includes the berths, is entirely enclosed and the entire car fitted with electric lights. The complete furnishings of a six room house can be loaded into the van 1000 cubic feet of cargo space being available

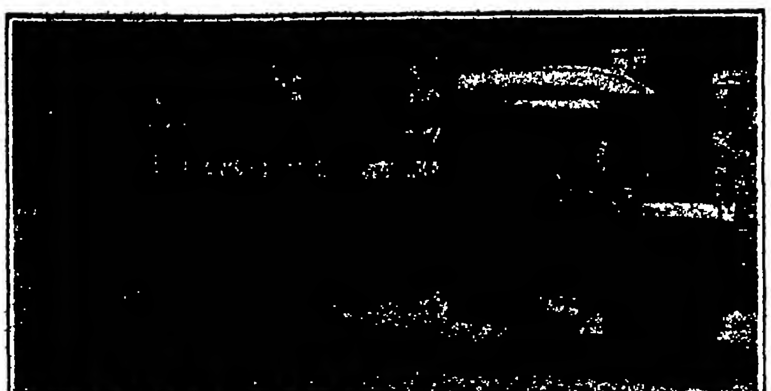
Moving Sixty Thousand Bushels of Peaches to Market

IN handling highly perishable fruit crops, notably peaches, motor trucks are being used to great advantage. Fruit growers constantly are adding to their truck equipment As an instance, one Georgia grower has purchased 37 trucks in the last two years.

At the largest nursery and peach orchard "plant" in the United States, Berlin, Md, two trucks carry the entire crop of 2500 acres of peach trees—a crop that this year amounted to 60,000 bushels—from the orchards to the packing house, where it is loaded into refrigerator cars.

Pickers in the orchards pick the peaches into ⅝ bushel baskets and the two motor trucks carry the baskets to the packing house Ordinarily the trucks each carry 150 to 175 baskets, and they make 12 to 15 trips a day each On one particularly busy day one of the trucks made 13 round trips, carrying 184 baskets on each trip—and made two runs to an orchard four miles away to carry employes. On another occasion one of the trucks carried a force of employees to a subsidiary orchard at Easton, aided in picking and packing $16,000 worth of peaches, and carried its crew the 75 miles back across the East ern Shore peninsula to Berlin—all in six days.

The peach season covers only a few weeks of each year But throughout the year there is work at the Berlin plant for the two trucks. In winter they carry shipments of nursery stock to the railroad. Besides they haul fertilizer and other farm supplies and engage in the many and varied jobs of transportation that continually present themselves



Two-ton truck used in general farm work outside of well-built garage used to house it

Inventions New and Interesting

A Department Devoted to Pioneer Work in the Various Arts and to Patent News

London's phonographic hustler for use on crowded subway platforms

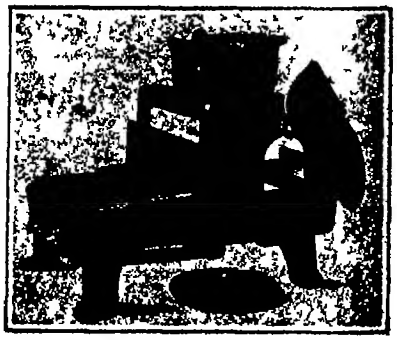
"Step Lively, Please!"

THIS and other cries now assault the ears of those who endeavor to clog the wheels of London's underground traffic by lingering on the escalators. They are shouted by a steel lunged giant with a throat of brass, and there is no doubt of their efficacy. The apparatus producing them is known as the automatic stentorphone, and the Underground Railway Companies of London have just adopted them to minimize delay and congestion at the escalators during the busiest hours of the day. The name is appropriate, for surely Stentor, the Greek herald god, would have been proud of his mechanical successor.

The device is a modification of the original stentorphone—an apparatus devised to reinforce and strengthen the tone given out by an ordinary gramophone record so that it can be clearly heard over the whole of an ordinary ballroom, cinema etc. The device acts by employing a strong blast of air, produced by a special blower, to produce and carry the tone. For ordinary use the stentorphone may be concealed in a cabinet of graceful design yet by a simple and instantaneous valve adjustment the volume of sound may be cut off entirely or widely modulated. As has been said above, any ordinary gramophone record may be used, and so a full selection of band and chamber music may be rendered in a large hall or out of doors without the expense of hiring a band or orchestra.

The harassed dance promoter will find the new invention a great boon. A ballroom without a good band is hopeless, and a poor band is as bad as none at all. But good bands, alas, are expensive, and not always attainable. This is where the stentorphone steps in. It can fill any sized hall or room, and the volume of sound can be modulated to fill the exact size of the room in which it is playing. Further uses are in the cinema, the sound of horses' hoofs, for instance, may be exactly reproduced, and the sound made to die away in the distance as the horses in the picture recede. For election addresses to open-air audiences the stentorphone has no rival. A record once made, and the orator may address his electors in a hundred towns simultaneously and not one word will be indistinct. A form of the device suitable to outdoor use is seen in the illustration. Dainty concealed instruments in cabinet and other designs are available for indoor use.

The latest application, that to which we referred earlier, has been secured by the addition of automatic equipment which repeats the chosen phrases indefinitely. An automatic time stop renders it unnecessary to give the instrument any attention whatsoever during the hours of operation. The London Underground authorities state that since its use there have been unprecedented order and rapidity among the huge crowds which tend to choke the escalators during busy hours. The result is that the platforms disgorge their passengers in much less time than formerly. It is, at all events, a strange experience to witness the violent start of the idling passenger when a giant voice, proceeding apparently from nowhere, adjures him to "Get a move on!" Perhaps we may look for an early adoption of the device in this country, and an assumption by the brass-throated monster of the subway guard's burden of imploring us to "Step right up to the middle of the car."



A bench furnace with many uses

For Him Who Fears a Draft

THIS invention is of value to one who wishes to protect his head—particularly if scanty of hair. It is an electrical cap, shaped like a Turkish fez, and is really of considerable value to one who wishes to sleep in an airy room or even on the porch in winter. The tendency of many people to draw their heads under the clothes after they have fallen asleep may be overcome by wearing this novel headpiece.—*By William Walsh.*

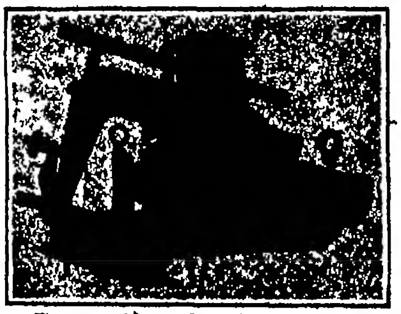
An electric cap for the draft-wary

The Bunion Shoe Tree

WE will naturally all admit that the shoe having a shoe tree in it when not on the foot is the best-looking shoe. These hollow metal shoe trees are adjustable and have an entirely new feature that makes them different from the others. On the right and left sides small metal buttons will be noticed. These are for the benefit of those who may have trouble with their shoes being too tight in particular places, causing corns to form. Anywhere a shoe pinches these metal buttons can be secured. They are said to succeed in stretching the leather over this point and making the shoe more comfortable.

The All-Around Bench Furnace

OPERATING direct from the gas mains this gas furnace is designed so that no blower is interposed, and besides heating soldering coppers it may be used for various other things. In the top of the combustion chamber a hole receives a twenty-pound melting pot for melting leads, babbitts or other bearing metals. Swinging doors on either side of the combustion chamber facilitate the placing of long rods for heating any part of their entire length. A lid at the front of the combustion chamber almost completely covers the opening and for inserting the soldering coppers a slit is provided at the top. The coppers are supported on a ledge in the rear of the chamber while being heated, and thus they are held clear of the bottom of the furnace and the tinned portion is out of the direct flame blast.



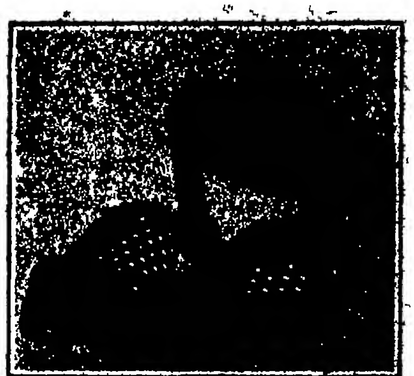
To cut rails as they lie on the ties

Sharpening Files by Electrolysis

BRITISH patent 161,611 of 1919, which has just come to our attention, reveals a method of sharpening files, rasps and the like by placing them in an electrolyte and applying a high-tension current capable of giving a spark of length equal to the average length of the files. The treatment lasts for a number of minutes corresponding to this length in inches. An induction coil may be used. A good electrolyte for the purpose is made with 86 parts water, 3 of nitric acid and 5 of sulfuric. The water and files go into the vat first, the acids being added after the current has been switched on. Before the treatment it may be desirable to wash the files, wire-brush them, give them an alkali dip, and dry them well.

Utilizing Old Film

THE emulsion, according to a recent statement by G. Bonwitt in *Chemische Zeitung*, is best removed with boiling water; acids, which accelerate the process, also damage the film body. Both the celluloid base and the washed-off gelatine are of commercial value. The latter is treated with sulfuric acid, and heated for perhaps half an hour; this causes complete precipitation of the silver bromide. The celluloid is mostly used in the manufacture of varnishes. Motion-picture film requires slightly different treatment, for here the celluloid base is most profitably preserved by recoating, and this requires that a more moderate heat be used.



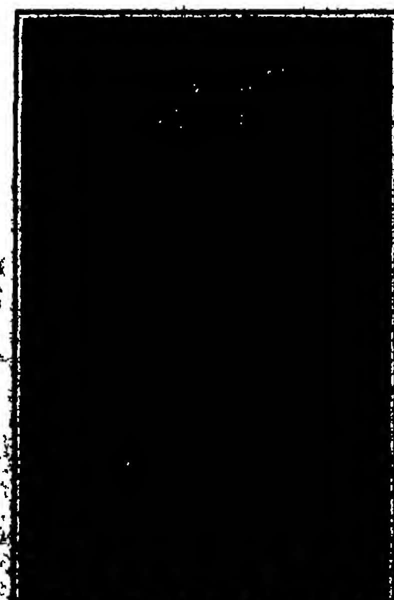
A shoe-tree for the game foot

A Portable Rail Cutter

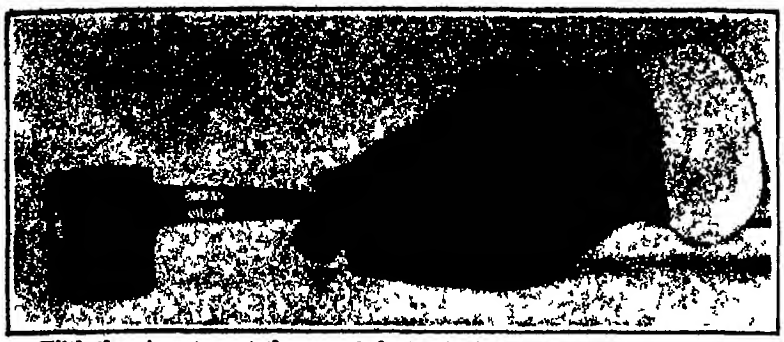
TWO men can easily handle this new portable rail-cutting machine, which is used for cutting rails without removing them from the track bed. An automatic lifting device lifts the blade free and clear of the work on each non-cutting stroke. The machine has a cutting stroke of six inches and operates at 100 strokes per minute. Operating current for the direct-connected motor is secured from a trolley wire or third rail. Quick acting clamping devices hold the machine firmly to the rail and secure a straight cut. It is automatic in so far that after the machine has started on a cut no further attention by the operator is necessary until the rail is cut through. —*By Allen P. Child.*

The One-Way Dust-Pan

ONCE the dust and other debris gets into this dust-pan it is there to stay. It can't fall or blow out until the house-cleaner so desires. It is



No dust can escape from this pan



With the pipe-stem at the top of the bowl, the sludge is kept completely separate from the smoke

to be especially noted that this pan is equipped with a top or cover. This may be raised or lowered by operating the lever at the top of the handle. With the cover raised the sweeper brings in with the brush all the debris into the receptacle. The device is self locking, so that at times as desired the operator may have both hands free. One particular advantage in its use also is that no bending or stooping is ever required of the housewife who goes about her cleaning with the aid of this pan.

Easy on the Eyes

A MANUFACTURER of reading glasses of Indianapolis evidently became tired of holding the old hand-grasp design, for he has designed one that holds itself in the desired position over the page, leaving the hand of the user free for other things.

In the examination of fine print of any description, maps, etc., it will be found easy on the eyes. It has come into use for the examination of finger prints in the identification of criminals and is found to contribute materially to the ease of this work.

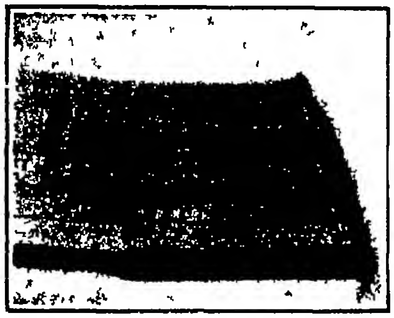
A New Idea in Valve Grinders

A VALVE grinder that operates in a way somewhat different from that known to the auto mechanic promises to cut down part of his monotonous labor in this process. The grinding edge of the instrument is made to rotate back and forth, but the hand of the operator—in this new device—always turns away from him, just as though he were working the crank of a grindstone. This is accomplished because the gears automatically shift back and forth, thus reversing point of application to the job.

The handle of this valve-grinder always turns in the same direction

A Pipe with the Stem at the Top

IN this newly designed pipe the condensable products of combustion commonly known as "sludge" or nicotine are separated from the smoke by gravity.



A self-supporting reading glass

The smoke is forced, by drawing on the stem, away from the sludge and rises through the open, spiral coil, which is formed in the coarse threads of the bowl to the smaller chamber above. It travels 20 inches from the beginning until it comes out through the stem.

The inventor claims the tobacco is always dry and therefore it is all consumed and none wasted. All sludge is held by gravity in the settling chamber as will be appreciated upon examination of the broken away drawing of the pipe which we present above.

Heater and Distributing Fan in One

THIS electric heater and fan form an unusual combination. By this method the heat is, of course, distributed more uniformly about the room. Both parts of the mechanism are of standard manufacture. Where it is necessary or desirable to place the heater upon a narrow table, shelf or other receptacle the compactness of the combination will be appreciated. Altogether, it seems to comprise a most happy combination.

The Newest Christmas Tree Lights

AMONG the Christmas novelties offered for the coming holiday season is a very convenient tree-lighting set which builds up in units of eight lights. In place of having to have 8-light, 16-light and 32-light sets, each entirely distinct from the others, we may now build up to these or to any number which our fuses will support by simply screwing the plug of one 8-light set into the socket of another. If an extra bright light is desired on any tree an ordinary lamp-bulb can be placed in the end socket in place of the special Christmas tree bulbs with which the set is fitted. Each 8-lamp unit includes the latest type of semi-flame lamp in red, white, blue green and yellow. The manufacturer points out that the set is not confined to Christmas use, but is available for lawn parties, weddings, hallowe'en festivals, and in general for all occasions when fancy illumination is desired.

A Drinking Fountain for the Faucet

BY attaching this device to any water faucet in the household a handy drinking fountain can be had. The rubber tubing on the end of the water supply pipe stretches to fit any ordinary sized faucet pipe. It will not interfere with the supply of cold water for the basin, as it will flow over the mouthpiece into the bowl if desired.—*By M M Hunting*

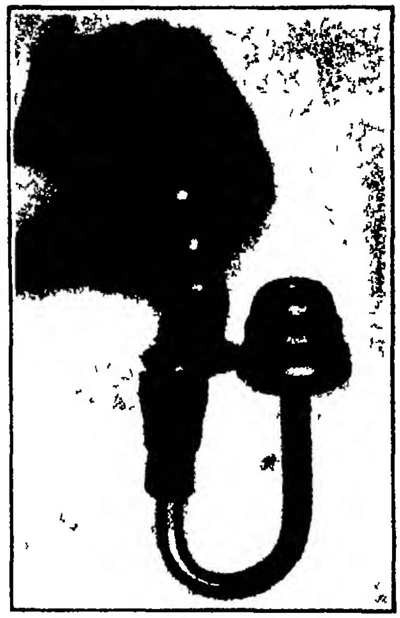
A "Revolutionary" Bicycle Drive

A HUNGARIAN engineer named Jaray announces the invention of a new type of bicycle called the J-wheel. This wheel is constructed on scientific principles and is intended to provide a better vehicle than an ordinary bicycle, for the use of men, women and children.

The ordinary wheel in present use makes use of human muscular power by means of a chain drive sprocket or a bevel gear drive. In this form of drive the forces of rotation which operate at the circumference of the crank drive, even with an impulsive force which remains the same, are not uniform during a revolution. It is possible, of course, according to the well known principle which operates in machinery construction to compensate in some measure this difference of velocity at the circumference of the drive wheel by a considerable momentum of vibration of the revolving parts in the case of large machines, but since these compensating 'working surfaces' are very large in proportion to the amount of work done in the case of a bicycle, it is not possible to obtain a satisfactory degree of uniformity in the case of a light bicycle except when the latter is

Electric heater with fan distributor

moving with great velocity. In these cases, however, in which it is important to extract every ounce of power which is possible from the bicycle, as, for instance, when great resistances need to



A drinking fountain for the faucet

be overcome, as in the case of bad roads, hills, or contrary winds, the rider frequently finds it impossible to overcome these obstacles since the wheel refuses to operate in the presence of the 'crank dead center' created by such resistance. This is why the common bicycle gives poor service in hilly country, etc.

Jaray has entirely rejected the use of a crank and has replaced the latter by a sort of lever drive, arranged in such a manner that under the operation of the normal foot power the circumference force upon the rear wheel remains approximately uniform during the entire lift. Consequently, the variation in the velocity remains nil in every case. Furthermore, each of the levels operated by the feet is in a certain measure independent of the other so that the lift of one can be begun before that of the other has come to an end, thus making it possible to avoid the dead center. The taking up of the foot power of reaction is effected no longer through the weight of the operator or by means of the pull of the driving rod but by means of a broad back support which is connected with the seat, and by means of this with the framework which makes it possible to exert a two-fold foot power, thus multiplying the weight of the rider. In this manner it is possible to overcome high degrees of resistance which suddenly make their appearance by means of a foot pressure amounting to as much as 150 kg., whereas it is scarcely possible to exert a foot pressure of more than 75 kg. in an ordinary bicycle.

A peculiar advantage of this invention consists in its avoidance of an uneconomic expenditure of power—it pre-

Outfit for lighting Christmas trees that builds up in multiples of eight

An inverted electric iron for pressing coats

vents any excessive friction of the joints thus preventing the early appearance of fatigue in its driver, furthermore, it eliminates the necessity of a cooperation of the muscles of the arms in order to help out the foot power, it also avoids the lifting of the body for the application of the driver's weight.

Other advantages in this new machine are the absence of a cog wheel, of a chain, of a shaft of self revolving pedals, while at the same time it possesses three translation stages which bear the ratio to each other of 66 100 136, which can be put in operation without any reversing but merely by a simple shifting of the feet.

Safety and Neatness in Switchboard Panels

THE well known switchboard panel, with its exposed switches and fuses for controlling a number of circuits in the factory is fast going out of date In the first place such a switchboard is dangerous, especially where the voltages exceed 220 volts Then again, it is not neat and businesslike and as often as not it is apt to gather dust and moisture which are not conducive to good electric service

The latest development in electric wiring consists of standardized panels which preserve every desirable electrical and mechanical feature in design and construction that could be secured by the most exacting specifications. Because of regularity in design, precision in manufacture and accuracy in assembly, they are superior to built to-order boards in many respects

These standardized panels are of molded composition They look better and are safer than the usual panels because the bus bars are off the front. There is more room on the front for branches and fuse connections. They are easier to connect up and get at, at any time. They cut down labor and material costs in installation. They are always and quickly available, one at a time or in quantities.

An Electric Tailor's Goose

THIS device makes the process of ironing the shoulders of a coat a much simpler one than has been the case in the past. It forms a convenient apparatus for any household It is really nothing more in its function than an inverted electric iron, for instead of pressing the iron down on the cloth the cloth is rubbed down over the iron

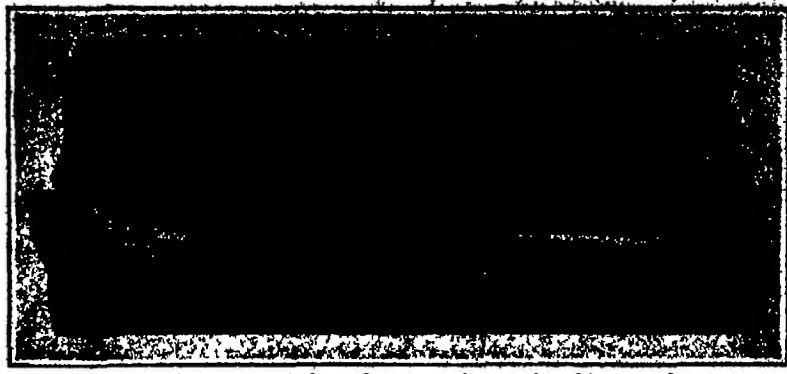
Street Signs in the Curbing

THERE is always a good deal of difficulty in designing a street sign of any description that shall have equal visibility by day and by night. The illustration herewith shows how San Francisco has attacked the problem The sign is built into the curbing at the corners. Small holes formed into the name of the street carry the name by day, and lights inside the hollow curb make them equally plain by night On a street where there is but a single traffic line in each direction this ought to work very well, we have our doubts about its satisfaction on a wide street with two or more lines, one of which would probably conceal the sign from the drivers in the other

The latest night-and-day street-sign consists of colored holes, with lights behind them, in a hollow curb

Primitive Methods of Measuring Distance

ONE of the curious customs of the Tibetans reported by the Mount Everest Expedition is the measuring of distance by the number of cups of hot tea a man can drink within a definite time This reminds one, according to a writer in *Die Umschau* (Frankfort), of the observation made by Harry de Windt while traveling in Siberia, that distances were measured by "kettles"—a kettle being equivalent to the length of time required to bring a kettleful of cold water to the boiling point. After all, these measures are not so very much cruder than the hour glass of very recent use



The non-skidding car-window; for convenience of making-up the page it is shown on its side

A Car Window That Will Not Drop

ABATEMENT of the nuisance of the car window which may suddenly and without warning drop on the hand or the arm of an unsuspecting passenger is obtained by the device illustrated herewith, which will effectively retard the downward movement of the sash, thereby preventing damage to the sash frame, glass and sash lock As indicated in the illustration, the inlaid springs are of different strengths, the heavy one being at the top. In raising the sash the shoe slides to the bottom of its channel and compresses the weaker spring, allowing the sash to be raised with comparative ease, at the same time preventing all rattle. In lowering the sash the shoe automatically slides to the top and compresses the heavy spring, as is shown in the illustration This increased pressure gives sufficient friction to prevent the sash from falling, and at the same time holds the sash firmly against the outer stops when the window is closed, preventing all rattling.

If preferred, this device can be placed on the edge of the stop casing adjacent to the sash, in which case application is made with the heavy spring at the bottom—since the descending sash here drops the shoe to the lower end of its channel.

Helicopter Progress

CHICAGO is the seat of the latest attempt to solve the helicopter problem Two brothers from the windy city, Leinweber by name, have developed a type of blade which is rather a departure, and which they believe will make machines of the helicopter type practicable.

Tests on the new blade have been made at Armour Institute and at Great Lakes Training Station The main attempt made is to lift-drive and balance in one unit by propellers. The propeller has been provided with a pitch designed to increase the working of the slower-moving parts to correspond with the faster-working ones. It is hoped in this way to distribute the thrust actively throughout the entire blade, and to drive the air directly away from the propeller in a dense ring coextensive with the propeller blades. A uniform suction of air in front of the propeller throughout the entire blade is also aimed at.

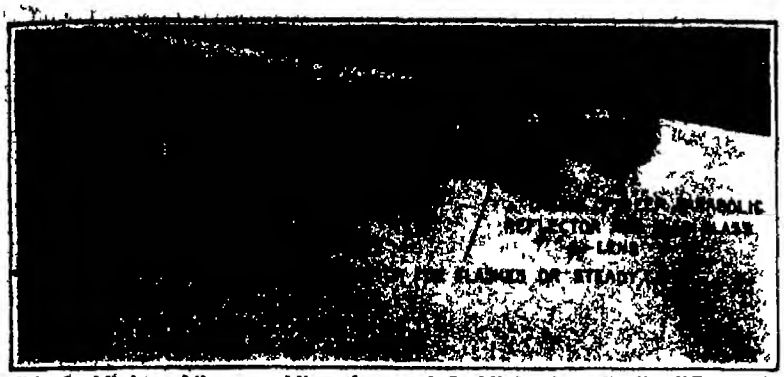
In the tests a machine weighing 1500 pounds was raised from the ground and held stationary in the air for several minutes at a time. The performance of this blade is highly creditable for the present stage of the helicopter art, and lends further emphasis, if any were needed, to the fact, rapidly being realized among aeronautical men, that we may no longer regard the mention of the word "helicopter" as a signal for smiles, laughter, and tapping of foreheads, but we may look forward with confidence to a day when the machine that "goes straight up" will be built.

Side view of the plane and blade assembly in the Chicago helicopter tests

Alining Pistons in a Hurry

BY using a device developed by a New York manufacturer it is possible to aline pistons and true up wrist-pins with perfect accuracy On the arbor of the device connecting rod bearings may be test-fitted in true alinement without the necessity of testing after placing in the car.

The newest apparatus for alining pistons and truing wrist-pins



This flashlight, while resembling the usual flashlight, is radically different in construction and throws a 300-foot beam

Something New in Flashlights

YEAR after year we have been accustomed to using flashlights of the conventional sort, throwing a beam of, say, 50 feet, perhaps 100, if we consider the dim illumination at that distance It has remained for an American manufacturer, however, to work out a new flashlight which throws a bright beam upwards of 300 feet, and which, for outdoor work at least, puts the flashlight on an entirely new footing.

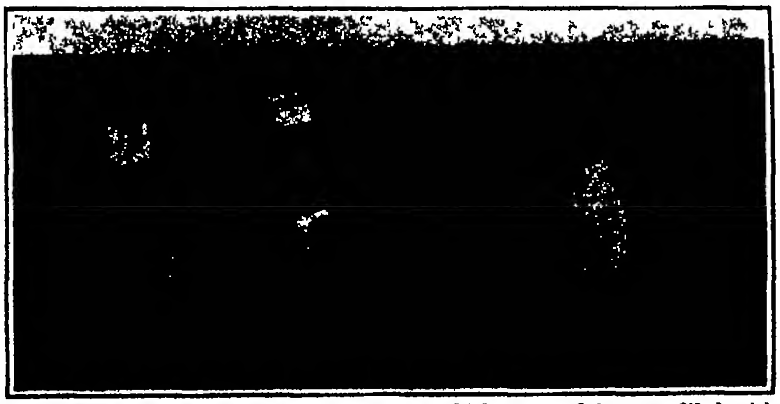
The secret of this sudden jump from 50 feet to over 300 feet is all in the matter of the filament and the parabolic reflector In the past, flashlight designers have employed crude reflectors, poorly silvered, and ordinary miniature bulbs, with no attempt whatsoever at focusing the rays. Heavy lenses have been employed, but these have been such crude molded affairs that they aided but little in concentrating the beam.

The present flashlight, which is shown in the above illustration, has no lens of any sort; in fact, a plain piece of glass is used in front of the bulb. However, a special bulb is employed, in which the filament is highly concentrated, while the parabolic reflector has been carefully designed and silvered. A ring at the other end of the flashlight controls the focusing of the beam of light. As this ring is turned, a sleeve moves forward or backward in the flashlight casing and shifts the position of the bulb so that its filament comes to the proper focal point. Thus the beam of light can be spread out for illuminating large, nearby areas, or narrowed down to a pencil like ray for covering small areas at the maximum distance. Three cells of dry battery are employed, the current being controlled by a simple switch. Two extra bulbs are always at hand in the compartment at the rear of the flashlight.

Selenium Cells That Are Different

HERETOFORE our best selenium cells have come from Europe. We must hasten to explain that selenium cells are devices which change their electrical conductivity according to the amount of light falling on them, and this characteristic has caused their employment for all kinds of service, such as turning on lights and controlling circuits when daylight gives way to night, enabling the blind to read by means of sounds, and so on But this account has to do solely with the cells themselves.

To Russell Hart of Los Angeles, Calif., goes the credit for having developed what appears to be an improved type of selenium cell This cell is made by fusing platinum upon a sheet of glass and engraving the electrodes with a suitable tool. The selenium is then applied in an extremely thin layer and crystallized by Mr Hart's own process on which he has patents pending. The porcelain cup, shown in the illustration, is filled with calcium chloride and sealed over the selenium. This feature makes the cell free from any variation in its operation due to atmospheric conditions. A strip of tinfoil is pasted over each electrode to protect the platinum foil when making contact.

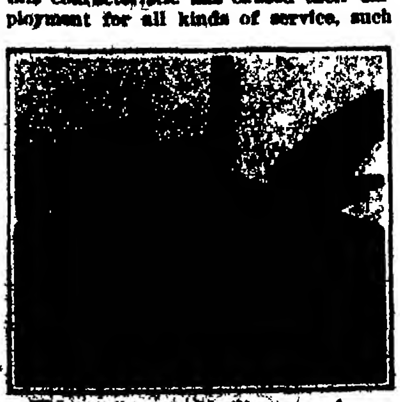


Two of the new type of selenium cells in which a porcelain cup, filled with calcium chloride, serves to exclude moisture

The regular selenium cell has an active surface ½ x ½ inch In direct sun light the maximum voltage is 22½ volts when the external circuit has less than 500 ohms resistance, and if over 500 ohms then 45 volts may be used with safety The full sunlight resistance varies from 10,000 to 20,000 ohms, and the dark values are 1,000,000 to 2,000,000 ohms.

Cannot Boil Over

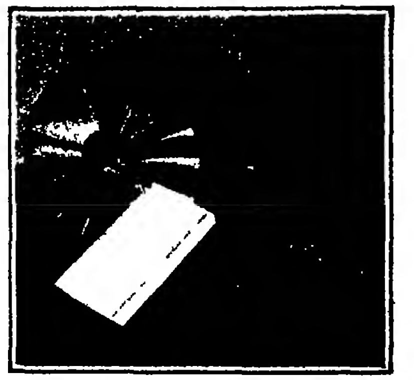
THE peculiar construction of this cooking vessel makes it impossible for it to boil over or burn the contents. The bottom has a steel jacket which holds the heat long after the gas is turned out. When cooking food comes to the boiling point, water will run up through the perforations, but back through the center hole which is in reality a float.



The annoyance of boiling over done away with by this pot

Revolving Directory for the 'Phone User

A CONVENIENT, ready reference directory for the telephone user is herewith illustrated. It consists of a core of wood, with slits, at intervals, into each of which a folded cardboard may be inserted. On each of these card boards there is space for half a dozen telephone numbers. Any card may be immediately inserted or removed as desired The periphery consists of celluloid, amber tinted. The whole, suspended on a wire support, revolves at the touch of the finger The device clamps to the telephone stand



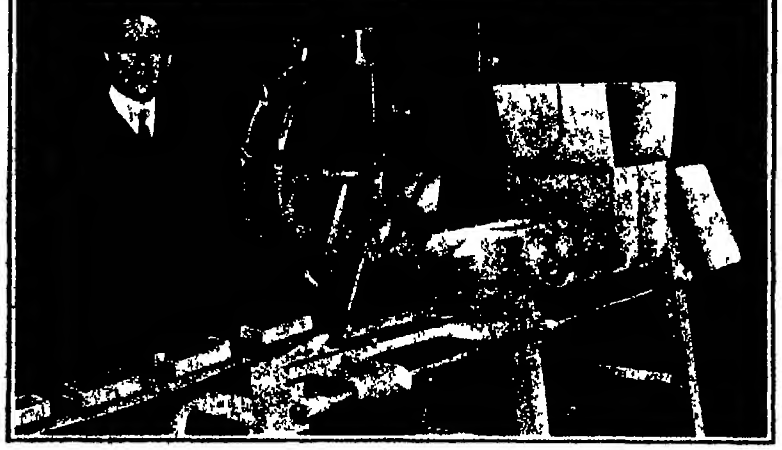
A revolving director which, being mounted upon a wire support, instantly gives access to its contents

Replacing the Wire That Cuts the Butter

SOMETHING distinctly new and revolutionary has just made its appearance in the butter business, and that is an automatic butter cutter Heretofore, even with all our vaunted mechanical ingenuity, we have cut print butter by means of wires, operated by men, while the butter was forced out of a forming machine in a steady square rod This crude manual method, aside from being slow, required considerable help and, because of its lack of accuracy, required a good margin of overweight which mounted into appreciable figures in every working day

Now comes I C. Popper, whose various alcohol-burning devices have been described in these columns from time to time, with the automatic butter cutter already referred to This machine is simplicity itself, and fastens on to any of the usual forming machines. As the butter is forced out of the former in a square rod, it strikes the cutting blades of the cutter wheel It pushes the wheel around, only to have the following blade come squarely down on it and cut a piece of butter of the requisite size. Still pushing along, another blade is brought down, cutting off another piece of butter, and so on The blades are so hinged and connected to rollers working over an eccentric cam that they come down with a straight cutting movement, yet turn up out of the way at the desired moment so as not to deform the cut butter An electric heater at the top of the machine heats the blades as they pass by The name can be stamped on the prints at the same time, all in one automatic operation

With hand cutters, the best day's run in one plant is reported as 27,500 pounds, using three men and one girl to a machine With the Popper machine, one plant has averaged 200 pounds per minute, or 900,000 pounds per working day, using only two men Furthermore, aside from the economy effected, the Popper method is sanitary because hands do not come in contact with the butter There is nothing to be thrown back into the former, since each cut is accurate There is a saving in moisture and weight, each print is accurate in weight as the weight can be controlled while the machine is in operation No extra power is required, as the butter leaving the former is the power, and the faster the butter is fed the faster the prints are cut



This wheel, equipped with blades, is the automatic butter cutter which speeds up the work of cutting print butter and eliminates considerable labor

Dirigible Stresses

NO simple but comprehensive method of calculating the principal stresses in the envelope of a non rigid airship has hitherto been described and published in the English language Report No 115 of the National Advisory Committee for Aeronautics describes the theory of the calculations and the methods which are in use in the Bureau of Aeronautics, United States Navy The principal stresses are due to the gas pressure and the unequal distribution of weight and buoyancy, and the concentrated loads from the car suspension cables.

The second part of the report deals with the variations of tensions in the car suspension cables of any type of airship, with special reference to the rigid type, due to the propeller thrust or the inclination of the airship longitudinally

A copy of the report may be obtained upon request from the National Advisory Committee for Aeronautics, Washington, D C.

The Heavens in February, 1922

Distances and Real Brightnesses of the More Familiar Individual Stars

By Prof. Henry Norris Russell, Ph.D.

As we look into the heavens on a cloudless night, the stars seem to be scattered over a gigantic vault, and we have no way of telling which is the nearest. We therefore instinctively think of them as though they were all equally far off, and speak of two stars as "near one another" when they seem close together in the sky. It is by no means an easy matter to pass from this superficial appearance to a knowledge *of the real distribution of the stars in space,* and to tell which are actually our nearer neighbors and which are remote. Yet the question is so often put, regarding the distances of specific ones among the brighter stars, that we may well spend a few moments in considering the answer.

We have several ways of measuring stellar distances. The most direct is based on just the same principle as that used in the range-finders which are employed with all modern artillery—except that instead of utilizing the small parallax or change in direction of the distant object as seen from the two ends of an instrument a few feet long, we make our "base" stretch across the earth's orbit some 180 million miles.

So accurate are modern photographic observations, that *if a star is a million times as far* away as the sun a single set of a dozen plates or so will suffice to measure the distance with an error averaging much less than 10 per cent. But if the star is further away than this, the angle of convergence of the lines drawn from opposite ends of the earth's orbit to the star becomes so small that even the minute uncertainties of observation involved in this method become important. Up to a distance of fifty light years (about three million times the distance of the sun) the direct method is still fairly trustworthy, especially if we can use the average *determinations of several good observers,* but beyond a hundred light years it is of little value. The observations, to be sure, inform us that the star is undoubtedly very remote, but do not enable us to say just how remote.

Our Immediate Neighbors

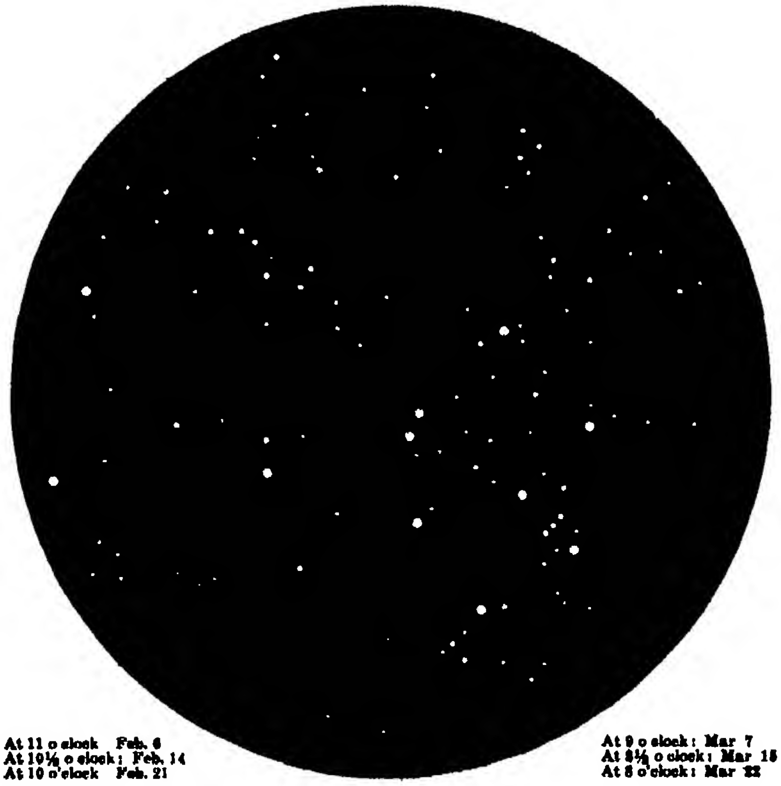
The brightest stars have naturally been the objects of special attention, and we have now good reason to believe that of the 22 stars which are commonly reckoned as of the first magnitude, just about half are within a hundred light years. Listing these in the order of distance we must begin with the brilliant southern star Alpha Centauri which as everyone knows, is nearer than any other in the heavens. Its distance, 4.3 light-years, is known within two per cent. And from this it follows that, of the two stars which compose the system, the brighter is almost equal to the sun in luminosity, and the fainter one only one-quarter as bright. The faint and remote attendant discovered by Innes two degrees away gives out less than one ten-thousandth of the sun's light, and appears to be nearer extinction than any other body which we can see shining.

Next in order comes Sirius, at a distance of 8.7 light-years—also known within two per cent or better—and a real brightness 26 times as great as the sun's. Only two other stars (both invisible to the naked eye) besides Alpha Centauri are known to be nearer than this. Third on the list is the other dog star, Procyon, distant 11 light years, and six times as bright as the sun, and fourth is Altair, at a distance of 15 or 16 light years and giving out nine times the sun's light. These two distances, though not quite so accurately known as the first two, are probably to be trusted to within five or ten per cent.

After this we come to the southern star Fomalhaut. This has not been so carefully observed as the others, and its calculated distance of 23 light-years may be fifteen per cent in error or possibly more. The percent*age error of the calculated brightness, 14 times* that of the sun, is twice as great. There is little doubt, though, that Fomalhaut is nearer us than the next two stars on our list, Vega and Arcturus. Both have been well observed, and both lie at a distance of thirty light-years or a little more but their distances are so nearly equal that we cannot say which is the nearer. The real brightness of the two must also be about the same, some sixty times that of the sun in each case.

After these we must place the twin stars of Gemini, Castor and Pollux, which as far as present data indicate are at nearly the same distance, and hence must be fairly close neighbors in space—though their motions are in different directions so that their present proximity will not last long on the cosmical scale of time. Castor has been much more accurately observed and its distance appears to be fixed fairly well at a little over forty light-years making its two components respectively ten and twenty times as bright as the sun. For Pollux the observations are scantier, and the estimated distance of 85 light-years and 80 times the sun's brightness may be considerably in error.

The next star in order is Capella. Its distance of 54 light years is fixed very accurately by another method. Spectroscopic observations revealed many years ago that it was a very close double, and Michelson's interferometer has made it possible to measure the apparent separation of the components, though no telescope yet built can reveal them directly to the eye. The spectroscopic data tell us the distance between the components in miles, and we can then work out the distance of the system from us. The combined light of the two is 200 times that of the sun, so that each component surpasses any of the stars we have yet mentioned. In this particular, however, Aldebaran is probably a close rival. Its distance appears to be between fifty and sixty light-years, and its true brightness about 100 times the sun's—but these numbers may be wrong by twenty per cent.



At 11 o'clock Feb. 6
At 10½ o'clock: Feb. 14
At 10 o'clock Feb. 21

At 9 o'clock: Mar 7
At 8½ o'clock: Mar 15
At 8 o'clock: Mar 22

At 9½ o'clock: March 1

NIGHT SKY: FEBRUARY AND MARCH

Beyond the Range of Triangulation

Beyond this we enter a region of increasing uncertainty, so far as the direct measures go. Regulus, the brightest star of Leo, should probably follow Aldebaran on the list, but the direct measures of parallax at Yale make the distance 100 light years, while Adams' spectroscopic method, applied to a seventh magnitude *star which is moving with the bright one, and is* doubtless at the same distance, give 60 light-years. If we take the average of 80 light-years, we shall do as well as it is possible to do at present. This would make Regulus about 150 times as bright as the sun.

For the more distant stars we have fortunately another string to our bow. Some of them in the southern heavens belong to the great cluster of stars, all moving together, which was discovered by Kapteyn a dozen years ago. The actual rate of motion of the cluster can be found from spectroscopic observations, and then the apparent proper motion of each star gives its distance. Thus it is found that, of the stars of the Southern Cross, Beta Crucis is 190 light-years distant and 700 times as bright as the sun, while Alpha Crucis, 220 light-years away, is composed of two stars, giving out 800 and 500 times the sun's light.

The reader may be impressed by the fact that our stars are getting brighter and brighter, as regards their real luminosity, as we proceed. This is inevitable, for all the stars we are talking about look to be of about the same brightness to the eye, and the remoter ones must of course greatly exceed the nearer ones in real brightness. This may prepare us to learn that of the two remoter stars in Kapteyn's cluster, Beta Centauri is 280 light years away and 2800 times as bright as the sun, and Antares 350 light-years distant and 3000 times the sun's brightness. The distance here assigned to the last few stars are not likely to be out, on the average, more than 15 per cent.

For the other distant stars we cannot do so well. Two of them are of the Orion type of spectrum, and it is fairly safe to assume that their real motions in space are slow, so the most of their apparent motion arises from the drift of the sun through space. Granting this, the far southern star Achernar (Alpha Eridani) comes out 1000 times as bright as the sun and 120 light years away, while Spica is 230 light years distant and gives out 1500 times the sun's light. Betelguese—another great star, though very different in color and spectrum, and of far larger diameter—has been well observed and an estimated distance of 200 light-years probably gives a fair idea of the truth, though this may easily be one-third greater or less. The corresponding brightness is 1200 times the sun's.

Last on our list come three tremendous stars, so far away that the direct method of attack is practically hopeless, and so bright in reality that Adams' powerful spectroscopic method gets into trouble because we know no other stars of similar brightness to serve as standards of comparison. For one of the three, Rigel, Kapteyn has made an estimate, based on an exhaustive study of the whole constellation Orion and the neighboring region, which deserves confidence. According to this, Rigel is almost 500 light years distant and about 13,000 times brighter than the sun. About the other two, Alpha Cygni and Canopus, we know very little. Both have practically no proper motion, and direct measures of parallax give vanishingly small values. In both cases the spectra indicate very great brightness, but it is exceedingly difficult to give numerical values. The best we can say at present is that these two stars are probably as far away as any others on our list except possibly Rigel. Estimating the distance at 500 light-years, we arrive at 6000 times the sun's brightness for Alpha Cygni. Canopus to our eyes far exceeds any other star except Sirius; and if it is 500 light-years away, its real luminosity would reach the amazing figure of 40,000 times that of the sun. These values are mere guesses, yet we have already evidence enough that the statement that the average brightness of Rigel, Alpha Cygni and Canopus is 10,000 times that of the sun, is about as likely to underestimate as to overstate the facts.

The Heavens

Half of the bright stars we have mentioned are visible in our evening sky, and no less than seven of the eleven lie in the southwestern quarter. Castor and Pollux are almost overhead, and Procyon below them in the south. Lower down and a little to the right is Sirius, while Betelguese and Rigel are well up in the

(Continued on page 158)

Our Readers' Point of View

The editors are not responsible for statements made in the correspondence column. Anonymous communications cannot be considered, but the names of correspondents will be withheld when so desired

Engineering in Truck-Tire Building

To the Editor of the SCIENTIFIC AMERICAN:

The article under the above title by Mr H W Slauson in your December issue is brought to my attention, and I am asked to take up some of Mr Slauson's points which are not in accord with the experience of my company While he does not say so in so many words, Mr Slauson's article tells us by inference that there is no general answer to the question—What kind of tires shall we use on our trucks? Our engineering staff heartily concurs in this. But there are several errors of fact and of theory in Mr Slauson's article Those will be apparent to the tire engineer and to those who have had a scientific training, for the benefit of the layman I wish to record the following corrections

The 8-inch pneumatic tire is not the normal size for a 2½ to 3-ton truck. When used (as it sometimes is) on a 2½-ton truck it is loaded beyond its rated capacity and fails to give adequate mileage It is never used on 3 ton trucks. The statement would be correct if written "is normally used on a 1½ to 2½ ton truck."

The idea that the inflation pressure of a pneumatic tire does not increase with increasing loads is erroneous. Tire deflection (flattening at the point of road contact) increases with increasing loads. This deflection causes a reduction in the volume of the air chamber, and since the tire has no appreciable distensibility, the air is naturally further compressed. In his preceding paragraph Mr Slauson has stated that "the hammer blows struck by the rear wheels as the vehicle passes over depressions or obstructions in the road greatly increases this (inflation) pressure." He then goes on to say that in the very large pneumatics the pressure, or load, on each square inch of surface of road contact will be the same as the inflation pressure per square inch *regardless of the load on the tire* Here are two conflicting statements, and were the last one true, then a tire inflated with water would be as effective in sustaining and cushioning the load as if filled with compressed air Also every road obstruction would flatten an air-filled tire to the rim A tire inflated with water would show no deflection or deformation beyond that possible in the elements going to make up the tire. Increasing loads would have no deforming effect until a point was reached where the tire structure could no longer resist the stress and would burst. Water is incompressible, but air is not

Mr Slauson dismisses the pneumatic truck tire from general consideration due to its relatively high first cost. He fails to credit it with increasing the earning power of the truck through increased speed *and radius of use*. He does not mention the saving in upkeep from better cushioning nor the reduced losses from cargo breakage nor the reduced fuel and oil consumption There is as distinct a field for the pneumatic as for the solid Enthusiasts have retarded the full recognition of its value by recommending it for any and every service but better judgment now prevails and the pneumatic truck tire is rapidly coming into its own

"The fact that the rubber of a conventional solid tire has no place to which it may flow when subjected to pressure" *is not a fact. It flows out into a "bulge" on the sides.* Cushioning qualities rather than resilience are increased by providing additional spaces for the rubber flow Restriction of this flow increases resilience.

"Replaceable" used in connection with the incompressibility of rubber might better be termed "deformable"

The tractive wave in a solid tire is most destructive in the zone of greatest rubber volume—the center of the tire Therefore a cushion type of solid tire having central air cavities is more efficient from the standpoint of dissipating this wave and eliminating its destructive effects than the side-notched tire.

The last sentence of the eleventh paragraph would be more scientifically accurate if 'stress" were used instead of "strain."

It seems to me that an article of this nature leaves the reader in the wrong frame of mind, particularly if he is a truck owner Mr Slauson has established the fact that there are differences in the operating characteristics of the three general types of truck tires, and having thus led the truck owner up to asking the obvious question, does nothing toward advising him which type to use.

New York. E P THACHER.

To the Editor of the SCIENTIFIC AMERICAN

Mr. Slauson's article in your December issue is most interesting. We fully agree with him on many points, we would, however, take issue with him in quite a number of statements he has made.

There is a general answer to the question, "What Kind of Tire Shall We Use on Our Truck?" Furthermore, it is most definite and as decisive as the answer to many questions in the motor as well as the business world. This answer may not be made in an offhand manner.

The motor trucking industry has grown to be a great factor in all branches of industry, including manufacturing, farming, transportation of freight and passengers etc No single motor truck could be expected to fulfill the duties of all of the many and varied types of service in which motor transportation is used Who will deny that there is a general answer to the question How Shall We Transport Our Merchandise? However it is only a matter of good business for the motor truck user to make a careful study of all conditions and factors entering into his transportation of products or merchandise before deciding on the exact type of truck to be used

This has led to the division of motor trucks under many general heads, such as trucks for delivery, light trucking heavy trucking, intercity hauling, passenger bus service, etc There is a general type of truck for any service but it is not a matter of good business to purchase a truck for any specific service without making a careful study of conditions and design of truck best fitted to the service in question

The same sort of thing is true of tires. There is a general type of tire for every service, but conditions must be analyzed before a satisfactory decision may be made as to the most practical and economical tire

We feel that the author's comparison of solid and pneumatic tires is not fair In the first place, a truck owes its right to existence to the fact that it is a transporter of *merchandise The profit or saving a truck may show* depends on the amount of merchandise hauled and the distance it is carried The former, a most important factor has been entirely neglected Best accounting methods take this into consideration This refutes the statement that one of the principal objections to the use of pneumatic tires on moderate size trucks is the cost."

Almost anyone will grant the cost of pneumatic tires on light delivery trucks is not excessive. If it were, they would not be so generally used Let us compare the tire cost of a light truck and moderate size truck in the following manner

Truck No 1 hauls ¾ ton load and is equipped with 34 x 5 tires. Truck No 2 hauls 2 ton load and is equipped with 40 x 8 rear and 36 x 6 front tires. *Figuring on present list prices*, on a 10 000-mile basis, tubes included and 5 per cent war tax added the tire cost per ton mile for truck No. 1 is $0 03544 for truck No 2 it is $0 02675. The tire cost of the smaller truck is 32 per cent greater

This is almost a theoretical case, as but very few trucks carry constant pay loads, but it illustrates our point. Much experience has shown that 10,000 miles or more may usually be expected from pneumatic truck tires which are properly used

Let us now consider the paragraph "Thus the principal advantages of the solid tire are—longer life than the pneumatic, its reliability as far as freedom from blowouts or punctures is concerned its low initial cost' The first two points, except punctures, which are not very common to truck tires, are wholly dependent on the proper care of the pneumatic tire We grant that they need to be closely watched, so do grease cups, oil gages and gasoline tanks, if trouble is to be avoided. The lower initial cost means little The question is, what is the final cost, radius of truck service maintenance and upkeep and rate of performing a given amount of work Many other things must also be considered before the conclusion, as to the best type of tire to be used, may be reached

Different types of tires have a very great bearing on *the efficiency and earning capacity of a truck.*

Cushion tires are undoubtedly an improvement over the old type of solid tire but they do not take the place of pneumatic tires A solid *as it is non-compressible can not* form as efficient a cushion as gas (air), which is highly compressible

We feel that the author is overly enthusiastic on the subject. It is too new a development to have been thoroughly tried under all conditions. Some very serious faults have already shown up in this type of tire one of which is very abnormal and premature wear, due to notching the tire to break up the traction wave. The elasticity of the rubber permits a movement of each segment between the notches. This movement is caused by the traction wave, and takes place while *the segment is in contact* with the road Rapid wear on one end and normal wear on the other end of the segment results in a very uneven surface This condition has developed to so great an extent in some cases that the tires had to be removed because of excessive jolting and strains transmitted to the truck

Akron, Ohio. R. D ABBOTT

To the Editor of the SCIENTIFIC AMERICAN

In an article by H. W Slauson, M.E., entitled "Engineering in Truck Tire Building," appearing in the December issue of the SCIENTIFIC AMERICAN, certain statements are made in the fourth paragraph. as follows

"If we consider the larger sizes of truck pneumatics—those which must carry inflation pressures of 140 pounds per square inch we find an interesting situation Regardless of the load on the tire the pressure for each square inch of road surface contact will be 140 pounds a pressure which may well serve to rut soft asphalt surfaces."

This is a feature of pneumatic truck tire operation overlooked by many county authorities and highway commissioners in their short sighted attempts to limit truck loads to an inefficient and absurd maximum Such highway engineers would not be tempted to permit the use of pneumatic-tired trucks *in preference to those of solid* or cushion tire if they realized that the pressure per square inch of road contact of the pneumatic tired truck is the same, regardless of the load carried and is based entirely on the necessary inflation pressure

Now I am not a mechanical engineer yet the foregoing statements seem so obviously erroneous that presumptuous as it may appear, I can not resist the temptation of adverting to them

The pressure on the roadbed depends upon two factors—assuming that the road is perfectly smooth—to wit the combined weight of the truck and its load and the area of the tire surface in contact with the roadbed

That is, the pressure per square inch on the roadbed varies directly with the load and inversely with the area of the tire surface in contact with the roadbed

The inflation pressure of the tire is merely an internal stress and can not affect the pressure on the road excepting only to the extent that said inflation pressure is a factor in determining the area of tire surface which, under the force of the loaded truck, comes in contact with the roadbed

Were it otherwise or as set forth by Mr Slauson then a pneumatic tire with an inflation pressure of 140 pounds would, if removed from the truck and simply laid on the road, exert a pressure of 140 pounds on each square inch of surface contact with the roadbed EDWARD MAAG

Prospect, Ohio

The Breakage of Gage-Glasses

To the Editor of the SCIENTIFIC AMERICAN

In your first issue of the new monthly an inquiry was made as to why boiler-water gage glasses break after coming in contact with metal either in cleaning or otherwise

This is a matter that came to my attention several years ago when I owned one of the early steam automobiles A pressure of 200 to 250 pounds to the square inch was carried and only the best quality of glasses could be relied upon It was well known to some of us in those days that one of those glasses could not be cleaned by a swab on a metal rod without causing breakage either at the time or soon after Breakage would seem to occur spontaneously whether or not the glass was mounted in its fittings. I learned from a source I have now forgotten that the cause of the breakage *was the destruction* (by a slight scratch from the metal rod) of the surface tension of the tube. This may or may not satisfy your applicant for information but it seems reasonable that stresses might be set up in the glass while cooling CHAS EDW PRIOR, JR.

Hartford Conn

About the Dinosaur

To the Editor of the SCIENTIFIC AMERICAN

I have just been reading the copy of SCIENTIFIC AMERICAN for August 27th 1921 and came across a serious scientific error in a short article on page 151 signed by C M Lewis discussing the dinosaur footprints in the Connecticut Valley

His last paragraph states "From the position of the tracks on the rock and the skeleton discovered scientists believe that dinosaurs were two-legged and not four-legged animals, etc.

This is entirely erroneous and should be corrected. All vertebrate paleontologists and most geologists are familiar with skeletons of dinosaurs which invariably show small fore legs and long powerful hind legs. The genus Anchisaurus is one of those which inhabited the Connecticut Valley and a skeleton of it has been found with four legs. Those dinosaurs usually walked bipedal, but came to rest on all fours when the prints of the small fore feet are clearly shown associated with the much larger hind prints. For further evidence I refer you to Prof F W Loomis of Amherst College, where a fine collection of footprints is on exhibit Prof R. S Lull of Yale University, Prof Talbot, of Mt Holyoke, Prof H S Osborne, of American Museum of Natural History in New York, and, in fact, any department of geology in the larger colleges and universities. It is too bad that such misstatements slip out, and I appreciate that in a paper which handles as diversified subjects as yours it is not always possible to have all the articles checked over by a technically trained man

WINTHROP P HAYNES

Hotel Santa Rita, Tucson, Ariz.

Recently Patented Inventions

Brief Descriptions of Recently Patented Mechanical and Electrical Devices, Tools, Farm Implements, Etc.

> *THE object of this department is to catalog recently patented inventions and design patents for ready reference. In view of the large number of patents covered, it is obvious that each notice must be confined to the broad essentials of the patent described and, in some instances, illustrated. The name and address of the inventor are given in every instance, to facilitate direct correspondence. Copies of the patent specification will be furnished upon receipt of 15 cents each. In a word, this is to be a meeting place for the man with an idea and the business man in search of an idea*

Pertaining to Apparel

SUSPENDED TROUSERS PROTECTOR.—E. L. RICHARDSON, 282 Macon St., Brooklyn, N Y The invention more particularly relates to waterproof protectors adapted for use in stormy weather to protect the trouser legs from rain which drips from the bottom edge of a coat. A further object is to provide a protector made of yielding material together with a suspension means for holding the same in proper position, whereby the protector will loosely fit about the leg without causing pressure. The device occupies but little space and may be readily carried when not in use

ADJUSTABLE HAT LINING — F GRUNIG and L. VAN HUELE, c/o Pullastic Co., 392 5th Ave., New York, N Y The object of the invention is to provide an adjustable lining for women's hats arranged to permit, first, to fit the lining to any size hat, and then fit the hat by means of the lining to any size head Another object is to provide a lining not liable to leave any marks on the user's forehead even should the hat fit closely or tightly on the head. A further object is to give a smooth, neat finish to the hat.

SOFT COLLAR.—J W FISCHER, 181 Schermerhorn St., Brooklyn, N Y This invention relates to wearing apparel and its object is to provide a soft turn-down collar arranged to maintain the front of the collar in proper shape without danger of wilting or curling up, thus enhancing the appearance of the collar Another object is to permit of readily placing the stiffening means in position on the collar or removing the same for convenient laundering of the collar

INFANT'S GARMENT — SALLIE W LAING, Shreveport, La. The object of the invention is to provide an infant's garment combining a baby waist, an abdominal binder and sleeping stockings, and arranged to permit of quickly and conveniently placing the garment in position on the infant to keep the infant warm and protect it against drafts of air, especially at the abdominal region Another object is to provide means for conveniently attaching a diaper to the garment.

Chemical Processes

METHOD OF AND APPARATUS FOR TREATING AND HANDLING SULFUR.—F J HILL, c/o J R. Jones, Welsh, La. One of the principal objects of this invention is to provide for the treatment and handling of sulfur in the molten condition in which it is delivered from the well, and to render it susceptible of immediate transportation and use. The apparatus consists of a steam jacketed casing, one end of which is closed, the other open, a conduit for the molten sulfur, and means for breaking up the molten sulfur into small particles and spraying the particles with water to granulate the sulfur (See Fig 1, p 139)

Electrical Devices

ELECTRIC SIGN—J L. LONG Woodland Wash The invention relates to signs of the so-called flashing type An object is to provide an electric sign which will permit the change from one design to another on the light-board without darkening the light-board Another object is to provide a pattern sheet having perforations adapted to effect the completion of circuits through the lamps, the sheet being provided with master perforations which are adapted to complete the path for the light circuit, operate a clutch and throw a switch.

ELECTRIC DRIVE FOR VEHICLES.—F BERGER, 100 E. 15th St. New York, N Y Among the objects of the invention is to provide means whereby the power necessary to drive vehicles of any given weight is considerably reduced. Another object is to provide a simple and easily operable control system whereby excess power generated in the power system is stored for future use, and whereby a battery used in conjunction with the power system can be changed at will by the manipulation of a single switch element.

DISPLAY SIGN—C F BOETTCHER, Box 452, North Platte, Neb, The invention relates more particularly to the illuminating means for display signs. An object is to provide a sign having means whereby the number of electric lights necessary to illuminate the sign is reduced to a minimum, the lights being so located that the entire matter to be displayed is uniformly and brilliantly illuminated The sign is of simple construction, neat in appearance and cheap to manufacture

Of Interest to Farmers

ROAD DRAG—J A. CUTRIDGE and J A WOOD, McLoud, Okla. The object of this invention is to provide a device of the character specified of simple and inexpensive construction for grading and rounding up roadways, wherein a scraper plate is provided having means at its ends for connection with draft animals to travel before and behind the plate, said plate having means for permitting either or both ends to be lifted.

TRACTOR PLATFORM—W J BERNARD, Box 154, New Iberia, La. The invention has for its object to provide a device of the character specified adapted for connection with the Fordson type of tractors, for providing a supporting platform on which the operator may stand when he desires, the said platform forming also a connection between the article being drawn and the tractor

BULL HOLDING INSTRUMENT—O E. HATCH, Box 465, Davenport, Iowa. Among the objects of the invention is to provide an instrument which is adapted to be positioned in the nostrils of the bull, grip the cartilage between the nostrils and hold the bull during the puncturing of the cartilage for the reception of a ring A further object is to provide an instrument which is so shaped as to form a guide for the passage of a trocar to puncture the cartilage.

BALE FORK.—H A. WATERMAN, Liberal, Mo. The invention has for its object to provide a fork especially adapted for handling bales of hay, wherein a supporting bar is provided, having means for supporting and permitting the same to be transported, together with a series of impaling hooks for engaging the bales, the hooks being so connected to the bar that they may be simultaneously held in operative position, or tripped to release the bales.

COTTON PICKING APPARATUS—A D ALVIN, address Alvin Mueller Cotton Picker Co. 321 Hicks Bldg., San Antonio, Texas The purpose of this invention is to provide an apparatus for picking cotton from the plants in the field, in which a pair of picking members are so constructed, supported and operated as to effect a complete removal of the cotton from the plant without collecting any matter foreign to the cotton and without injury to the plants. The device is provided with a wheel-supported chassis and adjustable picking members.

Of General Interest

BLACKBOARD—C. B. NEIL and R. R. BOGGS, Fannettsburg Pa. An important object of the invention is to provide a black board especially adapted for use in schools, the device being provided with means whereby the board may be raised or lowered to meet the varying conditions encountered during use. For instance, so that a child or teacher may write on the lower portion of the board without inconvenience. The board may be elevated so that the writing may be viewed by the students, and may be held in adjusted position. (See Fig. 2, p. 139.)

HAIR WAVE.—A. SCHAMER, 2580 Broadway, New York, N Y Among the objects of the invention is to provide a form of hair wave, or rather a pair of coacting hair waves, which will impart that conformation known as the Marcel wave. A further object is to provide a device which is simple and practical in construction and operation, so that women may use the waver at home without the assistance of a professional hair-dresser

REVOLVING HEEL.—T HAND, 5 West Pine St., Orlando, Fla. The object of the invention is to provide a mounting for revolving heels which can be applied to shoes without requiring the ordinary leather heel, which is capable of application by one inexperienced as a cobbler The device may be readily changed from one shoe to another, as well as permitting the renewal of the cushion or tread portion of the heel.

SQUEEGEE.—J F NELSON, 19 Prentice Ave., Greenfield, Mass. One of the principal objects is to provide a squeegee which is constructed with a flexible elastic strip of rectangular formation so as to expose all the working edges thereof for use, irrespective of the working space in which it is to be used. Another feature resides in the provision of a novel means for associating the resilient strip with its handle, to materially increase its strength and durability

TOBACCO PIPE.—H. GREGSON, 400 Fulton St., Union Hill, N J The invention relates to a pipe which is arranged to prevent burning out of the base of the bowl and thus insuring long life of the pipe. An object is to provide a chamber for the reception of the nicotine to prevent the same from passing into the pipestem and to the mouth of the smoker A further object is to insure an even draft and a uniform burning of the tobacco.

CLAMPING DEVICE.—P A. HOFFMAN, c/o Smead Mfg. Co., Hastings, Minn. This invention has particular reference to a device for clamping material such as books or papers together An object is to provide an automatic clamping device in which the books are constantly subjected to a predetermined pressure between the parts of the clamping device so that their assembled condition is maintained

HUMIDIFIER.—F B. SUMBECK, 1412 Idaho St., Lewiston, Idaho. Among the objects of the invention is to provide a humidifier which may be used in an ordinary cigar box and which will impart the same amount of moisture to all the cigars in the box, wherein the moist absorbent material used is in direct contact with all the cigars in the box.

WATER METER BOX.—N FOSNY, Santa Rosa, Cal. The invention relates to a protecting box for meters. Its object is to provide a construction which is extremely simple but strong enough to protect a water meter against the pressure of the earth when buried. Another object is to provide a protecting box wherein a removable cover is provided as a cap for the reinforced sides.

FLUSH VALVE.—G. D. SHOWERS, 112 Sixth Ave., Altoona, Pa. The purpose of this invention is to provide a flush valve which is quiet and efficient in operation, durable in service, simple in construction and repair, readily adjusted for timing purposes, automatic, and one which will discharge a predetermined quantity of water at each operation and can be varied by adjustment of the valve.

WINDOW.—C. B. WISE, 1298 No. 9th St. W., Cedar Rapids, Iowa. The object is to provide means for connecting a pair of sliding window sashes in such manner that the weight of one sash will counterbalance the weight of the other and thereby permit the sashes to be moved to open or closed position simultaneously. A further object is to provide means whereby the lower sash may be held in substantially raised position, while the upper sash remains in its normal closed position.

METHOD OF MANUFACTURING ORNAMENTATIONS AND FINISHED ARTICLES DERIVED THEREFROM.—G. J ENGEL, address Engel, Hess & Co., 48 W 36th St., New York, N. Y The invention relates to a method of providing an ornament of an extremely fragile and pleasing appearance, particularly adapted for association with wearing apparel, centerpieces, etc., and by means of which each individual element of the ornament will stand out in relief from the adjacent portion, as well as the background.

PLANT STAND.—D. F. LOUDON, 109 W 102d St., New York, N. Y. The invention aims to provide a plant stand in which primarily the parts may be arranged with respect to each other, to provide a compact unit capable of easy shipment and disposition within a minimum amount of space. A further object is to construct the device with arms capable of being readily adjusted and applied, to accommodate and firmly grip virtually any type or size of receptacle which is to be supported.

ATTACHMENT FOR PENCILS.—A. A. BECK, Puposky, Minn. The invention has in view the provision of an attachment which constitutes the means for associating an eraser with the end of a pencil, pen or other writing or drawing instrument, said means being designed also to function as a clip for retaining the instrument in a pocket. Another object is to provide in combination with a tubular attachment a sliding means for effecting a radial contraction or expansion to grip or release the eraser.

METHOD OF MANUFACTURING TUFTS AND ARTICLES DERIVED THEREFROM.—T A. BOWERS, 21 Franklin St., Watertown, Mass. The invention aims primarily to provide a method by which the fibers of strands will be firmly fixed in place. A further object is to provide a novel form of binder which will effectively grip upon the strands of fiber of which the finished ornamental device, in the form of a pompon, tuft or tassel, is composed.

PAPER OR BILL FILE.—H. HEEMAN and S BRAININ, 811 Jennings St., Bronx, New York. The invention relates generally to a file of simple and rugged construction adapted for portable use. An object is to provide a file of such construction that it may be readily made of one piece of metal, either wire or sheet, and so arranged as to present a plurality of spring-like fingers of varying lengths that individual pieces of matter filed may be independently removed.

TRAP NEST.—D. H. COWGILL, Box 159, R. F D. No. 2, West Newton, Pa. This invention relates to a trap nest provided with a door adapted to be closed by the hen when entering the nest. The general object is to provide a nest of boxlike form having a raised bottom rockably mounted to tilt forwardly and backwardly under the weight of a hen, a swinging door and a lever fulcrumed on the nest and slidably engaging the door to impart a closing movement.

BUILDING BLOCK.—VAN EMERY MAGENNAY, 608 So. Race St., Urbana, Ill. Among the general objects of the invention is to provide a reinforced concrete building block which can be constructed in a simple and inexpensive manner, and which will be light in weight, strong and durable, and by

means of which blocks in a wall may be securely locked, in addition to the mortar bond.

ATTACHMENT FOR EYEGLASSES.—L. J. [illegible], Ladysmith, Wis. The object of the invention is to provide a device by which a magnifying lens may be quickly and easily attached or detached to a pair of ordinary eyeglasses. It is also an object that the device for carrying and securely attaching the magnifying lenses be simple in construction and inexpensive to manufacture.

HORSESHOE.—W. J. CAHILL, Lincoln Ave. and Baltic St., Jamaica, L. I., N. Y. The aim of the invention is to provide a device of this nature which shall afford ample protection to the hoof of racing horses and at the same time embody good wearing qualities and extreme lightness. A further object is to provide a shoe including a channel member which when filled with a strip of metal, preferably aluminum, will quickly become roughened and will afford a good gripping contact of the surface to be traveled.

RAT TRAP.—T. NAGAYAMA, address Russell and Paterson, Hilo, Territory of Hawaii. An object of the invention is to provide a device which is especially adapted to catch rats and other rodents. A further object is the provision of a trap in which no bait is used, but in its place a sheet of transparent glass with a dark background forming one side of the trap serves to arouse the curiosity of the rat, who will be enticed to enter. The trap is very simple in construction, strong, durable, and practical in use. (See Fig. 3.)

PORTABLE FLOATING BREAKWATER OR BULKHEAD.—M. A. WHITE, 49 Elliott St., Beverly, Mass. The invention relates to marine apparatus or appliances. The prime object is to provide a device adapted to be anchored in a seaway in such a manner that as the seas wash thereover they will be broken up with the result that in the lee of the device the sea will be quiet and calm. A further object is to provide the device with a power plant that it may be moved under its own power from place to place.

REFRIGERATOR.—H. C. PIERCE, c/o Naive Spillers Corp., Nashville, Tenn. An object of the invention is to provide means whereby a circulation of air is induced through an ice or other refrigerant chamber and then through a cooling chamber where poultry, meats, eggs, fruits, vegetables, etc., are stored. A further object is to provide means for controlling the direction of the air, so as to carry off odors and maintain the desired low temperature.

SNOWPLOW.—J. V. MARYLAND, 218 12th St. So., Virginia, Minn. This invention has for its object to provide a device of the character specified adapted to be connected to the front of a motor vehicle and to be operated thereby, wherein mechanism is provided for steering the plow to permit it to follow turns in the road without strain on the plow or the motive power.

BUTTON FASTENER.—N. GURRWITSCH, address A. Livingston, 895 Fairmont Place, Bronx, N. Y. The invention relates to a detachable fastener having a button head provided with a shank to be engaged or disengaged by the fastener means. The general object is to provide a means that will securely hold the button in fastened position, and whereby convenience is promoted in the attaching and detaching of the button.

SELF-SERVING STORE.—F. E. JONES, San Diego, Cal. This invention relates to stores wherein the customers wait upon themselves by picking out articles and taking them to the cashier to complete the purchase. An object is to provide a store whereby an inventory of stock may be readily made, and the customer may review the entire stock as he passes along in one direction so that there will be no confusion by meeting others, and so arranged that it is easy for the customers to serve themselves and easy for the stock to be replaced.

PROCESS FOR THE MANUFACTURE OF IRON LEATHER.—O. ROHM, Darmstadt, Germany. Among the objects of the invention is to provide a process for manufacturing iron leather, which consists of subjecting the skins to a tawing solution of iron salts, adding a diluted solution of water glass to the tawing solution, and adding a solution of formaldehyde to the tawing solution.

BAG HANDLE HINGE.—F. C. BOTWRIGHT, 1709 Kater St., Philadelphia, Pa. An object of the invention is to provide an adjustable hinge which can be attached to any type of bag whereby at the will of the person carrying the bag the point of support of the bag with respect to the handle is varied to shift the weight from one side to the other. A further object resides in the provision of means whereby the load of the bag may be so shifted that the bag is automatically held away from the legs.

ATTACHING MEANS FOR SEPARABLE FASTENER ELEMENTS.—A. LEVINE and L. OFFERMAN, 334 E. 23rd St., New York, N. Y. The invention relates to means for attaching fastener elements to flexible supports, such as the flaps of brief-cases, pocketbooks, music rolls, or similar containers. The primary object is to provide a hasp which carries its own attaching means, which may be quickly and easily attached and will thus be a time and labor saving device.

EDUCATIONAL DEVICE.—E. LE R. MOORE, 4490 Arch St., San Diego, Cal. The object of the invention is to provide a device for teaching children and others number processes, spelling and other facts which may be associated together, as, for instance the color and its name, a fact of history and its date, wherein the device, being in effect a toy, engages the play instinct while it teaches.

HANDBAG.—M. DIAMOND, 74 5th Ave., New York, N. Y. The primary object of the invention is to so construct a handbag that the same will have a plurality of individual compartments. It is a still further object to so construct the bag that certain of the compartments are accessible without opening the bag, and that when the same is in open position all the compartments are readily accessible.

Hardware and Tools

SOCKET WRENCH.—F. I. SILVA, Box 206, Wailuku, Territory of Hawaii. This invention has for its object to provide a tool especially adapted for use with spark plugs wherein a series of sockets is provided any one of which may be brought into use, the wrench comprising a tubular body of polygonal cross-section having its ends of unequal cross-section and having movable sleeves of polygonal cross-section within the ends of the same adapted to be moved into and out of operative position.

LIFTING JACK.—H. M. KNOX, Penokee, Kan. An object of this invention is to provide a jack which is primarily designed for quickly raising the axle of a small automobile off the ground, and a jack in which the weight of the car will operate to maintain the same in elevated position after it has been raised by the jack. A further object is to provide adjusting means which will permit of the jack being used with axles of various heights.

STRAP WRENCH.—W. DUFFORD, 1206 Osage Ave., Bartlesville, Okla. The invention relates to wrenches for turning pipes, bars, or other round objects and more particularly to a wrench employing a flexible strap as the gripping medium, whereby to prevent marring of the work being turned. In such wrenches rosin or its equivalent is used to increase the adhesion of the gripping action, and an object is to constitute the hollow handle of the wrench a container for the rosin.

UPHOLSTERY NAIL.—C. W. TOBEY, Fairhaven, Mass. An object of the invention is to provide a nail particularly designed for upholstery or similar classes of work which will not cut or scar the fabric which it is utilized to secure. A further object is to provide a nail having a slightly resilient solid fiber head, which will obviate the danger of scarring the head when the nail is being driven.

REEL.—S. J. MARTIN, 1114 Irwin St., Woodlawn, Pa. This invention relates to reels especially adapted for use with fence wire or the like. The object is to provide a reel of simple and durable construction and extremely light weight, easy and inexpensive to manufacture and of such compact construction and management as to occupy a minimum amount of space.

PINCHCOCK.—W. S. AVERY, 2200 Highland Ave., Knoxville, Tenn. Among the objects is to provide a device of this type which is formed of a single piece of spring wire bent upon itself, and which may be conveniently manipulated to control the flow of liquid through a piece of tubing. A further object is to provide a tube clamp which will be simple and may be readily applied to a tube to effectively close the same and prevent leakage.

Heating and Lighting

FUEL BURNER.—H. P. PORTER, c/o Gypsy Oil Co., Tulsa, Okla. The invention especially relates to burners adapted for burning gas as a means for heating the water in boilers, though not restricted to such use. An important object is to provide a burner having means for efficiently employing gas under a low pressure, and for preventing back firing and eliminating much of the noise incident to the use of burners of this type.

FURNACE CASING.—N. FROST, Bloomington, Ill. In general the invention relates to furnaces for heating air to be circulated through rooms in a building and more especially to the casing for confining the air to be heated, to conserve the heated air, and to prevent leakage or radiation from the casing. Another object is to provide a casing constructed of sheet metal and asbestos or other insulating material made up in panels or sections readily bolted together.

AUTOMOBILE VALVE.—M. J. BARRETT, 82 Prospect Place, Brooklyn, N. Y. More particularly this invention relates to spring-actuated valves for use on gas pipes, which have lever means adapted to permit closing when the pressure of gas falls below a predetermined point. An object is to provide a valve which will automatically close when the pressure of the service pipe falls below a predetermined point. Thus, if the flame should be extinguished by reason of low pressure, there will be no flow of gas should the pressure again rise.

COOKING RETORT.—F. B. DONNELLAN, 106 6th St., San Francisco, Cal. This invention relates to means for inserting cans into and withdrawing them from a retort or cooking vessel in which the contents of the cans are cooked by steam of high pressure, and among the objects is to provide such means which will avoid the loss of steam in such operations.

Machines and Mechanical Devices

REVERSING MECHANISM FOR SHAFTS.—K. R. TELLEFSEN, 73 16th St., Brooklyn, N. Y. This invention has for its general object to provide a reversing mechanism adapted to be associated with drive and driven sections of a shaft, such as a marine engine shaft, whereby to effect with facility either a direct drive between the shaft sections or to bring into play a reversing means for giving reverse movement to the driven shaft section. (See Fig. 4.)

BORING MACHINE.—C. A. SMITH, 180 Canal St., Brattleboro, Vt. An important object of the invention is to provide a boring machine having novel means whereby the vertical and horizontal drills may be simultaneously fed to the work for drilling the hole at different angles into the work. The device is provided with means whereby the pieces to be operated upon are fed to and held in position while being drilled.

DISPENSING DEVICE.—A. E. CARLSON, c/o Nevis Consolidated Schools, Nevis, Minn. The invention is particularly adapted for use in connection with the dispensing of predetermined lengths of paper or towels. An object is to construct a device which shall be adapted to furnish strips of material from a roll, it being unnecessary to provide perforations in the body of the roll to permit of tearing the strip, the device automatically detaching the strip from the body of the roll.

FEED-TABLE FOR PRINTING PRESS.—I. BERKOWITZ, 5 W. 3d St., New York, N. Y. This invention has for its object the provision of a feed table in which by simple and ready adjustments a wide variety of sizes of paper can be accommodated on one table. The plate is provided with a plurality of grooves in alinement, and adjustable rods which can be moved to positions forming a series of guides for the edges of any desired size of paper.

STEAM FRICTION DEVICE.—F. T. SWANSON, Route 2, Box 391, Hayward, Cal. The invention has particular reference to a device for actuating the clutch on a cable drum or the like. The primary object is to provide a form of device whereby the gripping effect between the cable drum and driving medium therefor may be varied at will and the clutching effect graduated.

TEMPER SCREW.—J. BURNS, c/o Burns Tool Co., Okmulgee, Okla. The invention relates generally to temper screws employed in apparatus for drilling deep wells, its purpose being to lengthen the stroke of the tool step by step as the drilling operation proceeds, so that the bit will be certain to strike the bottom of the hole on each down stroke.

ROPE CONVEYER.—A. DEBUNGS, 161 Rue de Courcelle, Paris, France. The invention relates to wire rope systems with fixed cables employed in towing haulage and

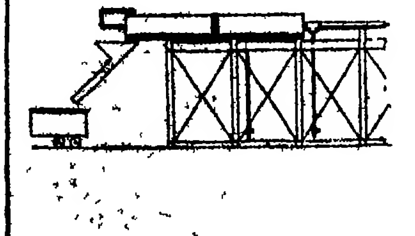


Fig. 1. Apparatus for handling molten sulfur from the well, invented by [illegible]

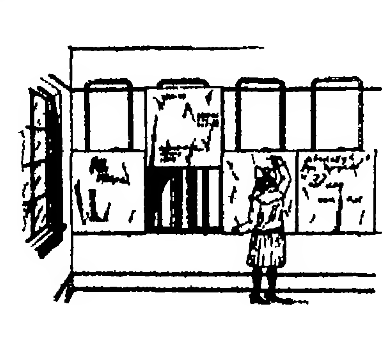


Fig. 2. Blackboard adapted for better display, patented by C. B. Neil and R. R. Boggs

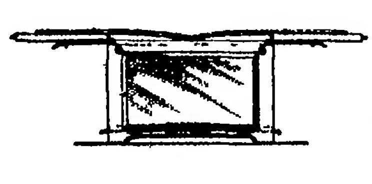


Fig. 3. The baitless rat-trap on which patent has been issued to T. Nagayama

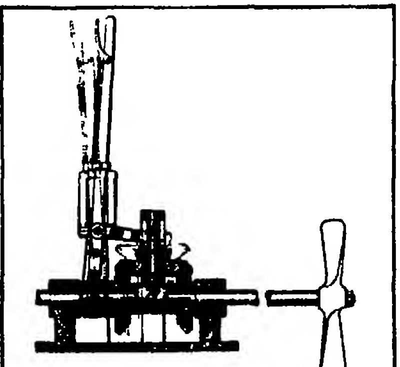


Fig. 4. The reversing mechanism for shafts devised by K. R. Tellefsen

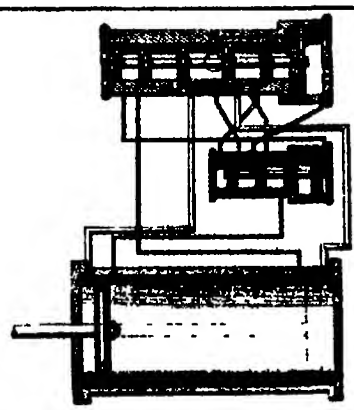


Fig 5. Automatic pressure-operated valve for pump engines, the invention of M. J Johns

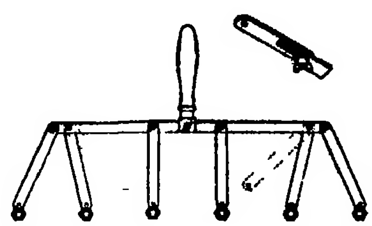


Fig 6. Tester for automobile engine that facilitates short-circuiting of the spark plugs, singly and in groups; invented by I. Montillio

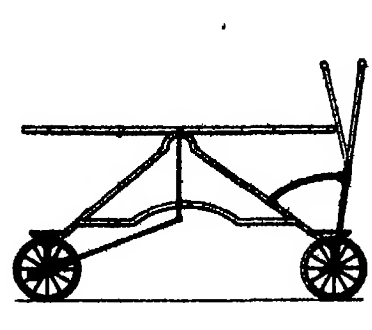


Fig. 7 Combination of toy vehicle and seesaw, devised by T B Keogh and L F Caumont

transporter plants comprising one or more cables, secured at the ends to anchorage and resting on intermediate supports Among the objects is to enable the cables to undergo certain longitudinal displacements in relation to their intermediate supports, with the result that the stresses acting on these supports are considerably lessened.

AUTOMATIC PRESSURE-OPERATED VALVE FOR ENGINES OF PUMPS —M J JOHNS, Box 474, Molstone, Mont. The invention relates to valve mechanism for effecting the inlet and exhaust of fluid pressure to and from a cylinder An important object is to provide a valve assemblage adapted to dispense with all connecting rods or the like between the piston and the sliding valve elements thereby eliminating the leakage ordinarily incidental to valves as usually arranged (See Fig 5)

DRILLING RIG —J J THOMPSON, 1758 W 24th St. Los Angeles, Cal The drilling rig referred to in this patent has for its object to provide mechanism for use in connection with the reel-controlling lever and on which said lever is mounted, to hold the lever in the desired position without the necessity of any attention on the part of the operator

COUPLING —W F DRUCKER, address National Mayonnaise Machine Co 207 Pacific St., Brooklyn, N Y An object of the invention is to provide a simple inexpensive and durable coupling for connecting a stationary beater such as are particularly adapted for mixing mayonnaise, to a support so that the stirrer, or beater may be securely held in position while the receptacle containing the mayonnaise is caused to rotate

FRONT ROLL STAND FOR SPINNING FRAMES —D C LEONARD and A P GREER c/o D C Leonard 94 Morris St., Greenville S C This invention relates to spinning and roving frames of cotton mills. A purpose is to provide a stand having a bearing which is adjustable to support the front feed roller in position to secure the proper tensioning of the yarn and which is removably associated with the stand to permit substitution of a new bearing when it becomes unduly worn The mounting of the bearing is such as to permit of both lateral and vertical adjustment.

Musical Devices

PHONOGRAPH CABINET —J BACHAR, 822 W 39th St., Chicago, Ill An object of the invention is to provide a phonograph cabinet in which records are maintained in compartments in the same casing in which the sound reproducing mechanism is housed A further object is to provide a device having compartments comprising a series of pockets for individual records, whereby each pocket may be marked so that the record may be quickly located.

Prime Movers and Their Accessories

ENGINE PISTON —Z A. BRUBAKER, 515 No 9th St., Boise Idaho Among the objects of the invention is to provide a lubricating system for internal combustion engines, and particularly a piston construction to effect a predetermined distribution of oil within a cylinder A purpose is to provide one or more channels on the inner side of the piston which are formed to catch the oil as it is thrown into one side of the cylinder and to deliver the same to the opposite side thereby effecting a proper distribution and preventing uneven wear.

INTERNAL COMBUSTION ENGINE —E. V PLUSH, Turon, Kan The foremost object of the invention is to provide a carbureter so combined with the engine that use is made of compressed air created by a part of the piston, to convey the fuel to the working chambers, the carbureter including means whereby the stream of compressed air may be either partly or wholly diverted from the spray nozzle, to obtain variously proportioned mixtures.

CARBURETED FUEL SEPARATOR AND FUEL VAPORIZER.—C. F SMITH, 814 W Mulberry St., Kokomo Ind The invention contemplates the use of means in connection with an intake and exhaust manifold whereby to receive and separate fuel flowing from a carbureter to the extent of withdrawing the heavier particles of fluid from the well broken particles suspended in the air which pass on to the intake ports, the heavier particles so separated falling upon a surface heated by the exhaust gases so as to vaporize the same in order that they may rise into and join the flow of well broken fuel

VALVE OPERATING MECHANISM —F B McLEAN, 138 Broadway, Ocean Grove, N J The invention aims more particularly to an apparatus serving to operate valves of internal combustion engines with a view to varying the power of the engine. An object is to provide means for operating the motor with the utmost economy where a relatively small amount of power is required, but when necessary it will be possible to increase the power to such an extent as to develop the maximum efficiency from the motor

AUXILIARY AIR INTAKE FOR INTERNAL COMBUSTION ENGINES —J BACON, 139 W 36th St., Los Angeles, Cal The invention has reference more particularly to an automatically operated auxiliary air intake which is applicable to the intake manifolds of engines between the charge forming device and the engine It is the purpose of this invention to so construct the device that the engine may be operated with an economical saving of fuel

ENGINE TESTER.—I MONTILLIO, c/o Wm E. Thompson 314 San Benito St, Hollister, Cal The invention relates particularly to a manually manipulated device for use in testing the ignition system of internal combustion engines through the medium of short circuiting the spark plugs. The object is to provide a device which may be manipulated with convenience, which is simple and practical and at the same time so constructed that it may be used to test engines of various types regardless of the number of cylinders or the relative position of the spark plugs. (See Fig 6.)

Railways and Their Accessories

STATION INDICATOR.—G M GRATTT, 322 Haywood Bldg., Asheville, N C. An object of the invention is to provide an electrically operated and controlled indicator adapted to be positioned in the end or ends of a car, and which will indicate to the passengers the stations as they are approaching the same, thus relieving the conductor or brakeman of the necessity of calling out the stations and to prevent the misunderstanding of such calls. A further object is to provide means by which all of the indicators in the cars of the train can be simultaneously operated

RAILROAD TRACK CONSTRUCTION.—P H. SAMPSON, 210 N Buttrick St., Waukegan, Ill. The general object of the invention is to provide a railroad track construction which has means for keeping the two rails equidistant from each other at all times. A further object is to provide means for securing the rails to the ties, and for preventing the nuts on the bolts which hold the sections of rails together from becoming loosened, and to provide means which will require less attention to keep the track construction in order

SLACK ADJUSTER.—C F KAHLER, 757 Railway Exchange Bldg, Chicago, Ill The invention relates to slack adjusters for brakes. An object is to provide an adjuster for railroad cars in which means is provided for automatically maintaining the brake shoes in the required position with respect to the wheels to insure the brakes being applied uniformly to the wheels with minimum travel of the operating parts. A further object is to provide a device which is not liable to get out of order easily

GRADUATED RELEASE DEVICE FOR AIR BRAKES.—G A ANDERSON, Santa Rita, N M The prime object of this invention is to provide a simple and inexpensive arrangement whereby the brakes will be released in a graduated manner proportionate to the increase or building up of train pipe pressure A further object is to provide a device which may be readily applied in connection with standard fluid pressure brakes and will be readily accessible for purposes of adjustment or repair

TRAIN STOP —G P HORAN, 12 Madison St., Rutland, Vt. This invention more particularly relates to means for automatically causing the stopping of a train if it attempts to pass a danger signal A further object is to provide means for opening the air line of the air-brake system of a train, so as to automatically apply the brakes and stop the vehicle if it attempts to pass the signal

Pertaining to Recreation

TOY VEHICLE.—H J LEACH, address Howard P French, Mount Carmel, Ill. Among the objects of the invention is to provide a child's vehicle, more particularly in the nature of an automotive vehicle, including a propelling means, gears, levers, etc., and certain mechanism for varying of speed and rearward movement, conforming in general characteristics at least to the essential operating levers of an actual automotive vehicle

GAME.—F H ANDERSON, 33 Bell Ave., Paterson, N J The invention relates to a game, the primary object of which is to provide a recreation serving to cause the participants to indulge in physical exercise, and at the same time quickening their faculties. The device consists in providing a number of projectiles and means serving to cause the same to be thrown into the air to be caught by the players.

SEESAW AND TOY VEHICLE.—T. B. KEOGH and L. F CAUMONT, address L. F Caumont, 98 3d Ave., New York, N Y The invention has for its object the construction of a toy which will act as a vehicle for transporting one or more children, and at the same time acting as an amusement device. Another object is to provide a vehicle with a seesaw or walking beam member arranged to propel the vehicle by the children while riding. The device is so constructed that it may be readily folded into a small space when not in use. The device is illustrated in sectional elevation in Fig. 7.

Pertaining to Vehicles

WAGON BODY —J SPEED, 123 6th St., Long Island City, N Y The invention relates particularly to such bodies as are designed for use in connection with motor trucks for heavy load service and reliable operation Among the objects is to provide a floor structure for a truck or wagon body having peculiarly strong, reliable and efficient stake supporting means. Another object is to improve the construction of wagon bodies with respect to the combined floor sills and stake supports.

AXLE-MOUNTING —N J GONDOLF, 5049 Constance St., New Orleans, La. The invention more particularly relates to a spring-supported wheel, the object being to provide a quick-acting and constantly effective means in connection with wheels, whereby to take up inequalities in the roadway surface for which the ordinary body springs are more or less ineffective. A further object is the provision of means which will assist in absorbing the rebound as well as promote greater life due to decreased wear of the parts.

WHEEL LOCK.—D J RADDICK, 603 Mission St. San Francisco, Calif The principal object of the invention is to provide a chock or the like capable of being locked to an automobile wheel to prevent theft, and which is locked to the wheel in such a manner that it can not be manually or otherwise turned around or twisted upon the wheel Another object is to render the device adjustable so that it may be used on any size wheel. The device is light and neat in appearance and easy to manipulate

PNEUMATIC TIRE.—C F A GRAY, 46 Richmond Square, Montreal, Canada The invention has particular reference to that type of pneumatic tire cover or shoe wherein an inner carcass or casing is located between the air container and the outer casing, and in which the outer casing is relieved of the greater of the internal strain exerted by the inner tube when inflated Among the objects is to provide a tire cover or shoe possessing two separate carcasses and an interposed resilient cushion to sustain the inflating force of the inner tube

REINFORCING PLATE FOR AUTOMOBILE BUMPERS —H BERNSTEIN, 306 E. 38th St., New York, N Y An object of the invention is to provide a simple and strong device adapted for use with automobile bumpers for the purpose of eliminating the tendency of bumpers to break along those portions which are adapted to be attached to the body or frame of the automobile. Another object is to provide a reinforcing plate to permit the required strength, at the same time permitting a ready adjustment of the bumper

AUTOMOBILE DOOR LATCH.—D. B. LAUZON, 4048 No. Le Claire, Chicago, Ill. The invention has special reference to a door latch for automobiles, the principal object being to do away with the side motion in pushing the latch to open it, thus permitting the opening of the door with one motion from the outside or the inside of the car. The invention further contemplates a construction which obviates the protruding handle, which necessitates two distinct motions in the opening of the door.

POWER STEERING DEVICE FOR TRACTORS.—O. L. LEWIS, 336 W. 69th St., Chicago, Ill. The object of the invention is to dispense with the actual labor

involved in the manual manipulation of the ordinary steering arrangement, which, particularly in large, heavy tractors and upon uneven ground, is fatiguing to the operator. A further object is the provision of a steering device which may be controlled by means of flexible lines from the operator's station either on the tractor itself or upon a trailing vehicle drawn thereby.

MOTOR VEHICLE AXLE.—A. MUENK, 480 29th St., Oakland, Cal. This invention relates generally to axles for motor vehicles but has reference more particularly to a rear axle and mounting therefor which is especially applicable to withstand the hard usage in motor stages, trucks and other such vehicles which carry heavy loads. An object is to supply an anti-friction device in the form of a double row of ball bearings properly confined in a race. (See Fig. 8.)

HEADLIGHT.—E. G SYLVESTER, c/o Model Sanitary Barber Shop, Honolulu, Territory of Hawaii. This invention has for its object to provide a device of the character specified, especially adapted for motor vehicles, wherein the lamp is so mounted and connected with the body of the vehicle that it may be moved toward or from the vehicle and may be turned with respect to its support to permit the lamp to be adjusted in any position.

THEFT - PREVENTING ATTACHMENT FOR STEERING WHEELS.—E. T TILDEN, West Concord, Minn. This invention relates to an attachment for preventing the manipulation of the steering wheel and throttle lever of an automobile. It comprises a casing formed of suitable metal and of such a contour as to completely house a steering wheel. The attachment being in semicircular sections, the smaller section may be folded into the larger, with the chain and other parts of the device, for convenient storage when not in use. (See Fig. 9.)

DEADLOCK FOR END DROP-GATES.—C. C. BREAKFIELD, c/o Jesse B. Boyd, Allensville, Ky The object of the invention is to provide a simple, inexpensive and easily operated lock which will hold the end gate in closed position without danger of accidental release, and which may be easily released when desired to permit the gate to drop into open position. A further object is to provide a folding rack which may be used with an ordinary bed of a wagon body

SHOCK-ABSORBER FOR AUTOMOBILES.—F SACKETT, 3511 Genesee St., Kansas City, Mo Among the objects of the invention is to provide a shock-absorber which can be applied to an automobile of a well known type without any changes to the latter and without the use of special tools. A further object is to provide means for preventing "side sway" of the body of the vehicle and for resiliently dissipating the shocks and jars and checking the rebound without impairing the efficiency of the springs ordinarily installed.

DOOR FOR AUTOMOBILES.—J J MCGUIRE, 21 Sherman Ave., Yonkers, N Y An object is to provide a door of the glass panel extension or window type, arranged to permit of folding the window within the door whenever it is desired to convert the automobile body from an open to a closed one, and to allow of raising or lowering the window to suit the occupant. Another object is to provide a window that is self-contained in the door and is adapted to be moved in guideways forming part of the door itself.

AUTOMOBILE LOCK.—S. B. CLAYTON, 432 Church St., Greensboro, N C The invention relates to locking devices for preventing the surreptitious use of automobiles. A purpose is the provision of a locking device which is adapted to lock the steering gear in such manner that upon unauthorised movement the vehicle will be caused to travel in an unchangeable direction. The device is simple, inexpensive and adapted to steering gears of the standard construction.

SPRING WHEEL.—A. F. MCGRATH, 331 E. 100th St., New York, N. Y. The general object of the invention is to provide a wheel of the indicated type improved in various particulars with respect to the arrangement and form of the resilient spokes and springs, whereby to provide for yielding of the wheel rim relatively to the hub portion. The device is characterised by strength and simplicity as well as convenience of assemblage.

DIRECTION INDICATOR. — E. F. KIMMERLE, P. O. Box 557, Oakland, Calif. The object of this invention is to provide a direction indicator of the semaphore type for use on motor vehicles. The device may be mounted upon the vehicle and manipulated by an occupant, preferably the driver, for conveniently indicating an execution of a right or left hand turn or stop. The primary object is to provide an indicator which will comply with the universal signal regulations.

DIRIGIBLE HEADLIGHT.—G W J CRABB and E. J RENNIE, 16 Munn Ave., Orange, N J One of the principal objects of this invention is to provide means for dirigibly associating a headlight with a vehicle in such a way as to reduce the vibration of the headlight to a minimum. An other object is the provision of means by which the headlights are turned an equal degree in order to maintain the concentration of the rays. The lights may be adjusted so as to be applicable to vehicles of various sizes.

SPRING MOUNT FOR VEHICLES.—H. B. BACON, 418½ 3rd St., Virginia, Minn An object of the invention is to provide a spring mount having means for obtaining a maximum resiliency with a minimum oscillatory movement of the frame of the vehicle to which applied relative to the axles of the same. A further object is to provide a device designed to operatively connect the side frame members of the vehicle with the axles without the necessity of making extensive changes in the construction of the vehicle.

ORE CAR.—A. ROY, Box 222, R. F D No. 2, Huntington, N Y The invention aims to provide a car of this nature, the body of which is hinged in connection with its truck and is provided with a normally upstanding shovel extension at its front end

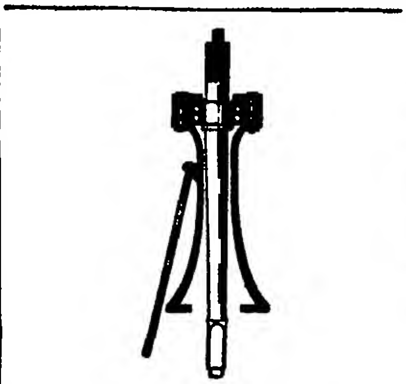


Fig. 8. Rear axle for automotive vehicle designed by its inventor, A. Muenk, to better withstand frictional wear

so that when the body is tilted to vertical position the shovel and the body act as a scoop in order to provide for self filling of the car by simply forcing its shovel extension into an ore pile

FOUR WHEEL DRIVE.—R. D SMITH and A. CHRISTOPHERSON, c/o G O McMoniney, Craigmont, Idaho. The primary object is to provide a simple four-wheel drive structure by which, in addition to furnishing traction through the rear wheels, the front wheels may also be used for driving purposes, as well as steering purposes, and will allow the necessary rocking and swinging or turning movements to compensate for unevenness in the road surfaces, while the driving parts are so constructed and arranged as to be driven from a common motor

AUTO ATTACHMENT.—F C. MILES, 2017½ J St., Sacramento, Calif The invention relates more particularly to Ford automobiles. Its object is to provide a bearing means for the rear axle housing of the same A further object is to take the weight of the housing from the axle altogether and have it supported by the wheel through the medium of the brake-drum, so that the only work to be done by the axle is that of rotating the wheel. This special attachment replaces the roller bearing and roller bearing sleeve found between the axle and its housing in Ford cars as now constructed.

SWITCH.—A. H PERRY, DeWitt, Ark. The invention relates to a device for use on automobiles whereby to control the ignition circuit by the angle assumed by the vehicle in ascending or descending unusual grades. Among the objects is to provide means whereby the movement by gravity of a suitable graded device may operate to control the ignition circuit. A further object is to provide a device which may be adjusted to operate whenever the vehicle may assume any predetermined angle.

ROTARY JACK FOR VEHICLES.—F B. URBANO, 16 E. 47th St., New York, N. Y. The general object of the invention is to provide a rotary jack for use in connection with automobile wheels to be applied over the tire casing to constitute applied tread and having an eccentrically disposed auxiliary tread to act as a jack, whereby the device, in addition to its usefulness as a jack, may function as an ordinary tread when applied over the casing of a deflated tire that the vehicle may run without damaging the same.

VEHICLE DRIVE.—E. S MILLER, Massillon, Ohio. An object of the invention is to provide a vehicle with a propelling means consisting of an endless belt mounted upon pulleys and driven by one or more of said pulleys, said belt contacting with the outer surface or periphery of the wheel and causing the wheel to be turned by the frictional engagement of the belt therewith A further object is to provide a vehicle wheel consisting of a pneumatic ball or spherical member comprising a pneumatic cushion and operated by contact of an endless belt.

Designs

DESIGN FOR A HAIR FRINGE.—M MULLER, address Wm. Kaufman, 1482 Broadway, New York, N Y

DESIGN FOR AN AUTOMOBILE.—J M. KAWANAMI, 8 Shima Tract, c/o C. M. B. Co., Stockton, Calif.

DESIGNS FOR A POWDER CONTAINER OR SIMILAR RECEPTACLE.—C. S HUMPHREY, c/o Manhattan Can Co., Bush Terminal Bldg, No 10, Brooklyn, N

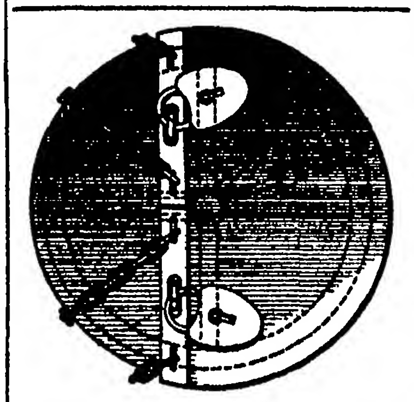


Fig. 9. Theft-preventive attachment for the steering wheel, the invention of E. T Tilden

Y The inventor has been granted patents on twelve ornamental designs for powder containers, comprising upper bodies of circular, oval, or elliptical formation, and lower bodies, triangular, oval, sector-shape, or square.

DESIGN FOR A DOLL.—RUTH H USHER, 44 Hanson Place, Brooklyn, N Y

DESIGN FOR A POWDER-CONTAINER OR SIMILAR RECEPTACLE.—C S HUMPHREY, c/o Manhattan Can Co, Bush Terminal Bldg., No. 10, Brooklyn, N Y

DESIGN FOR A TEXTILE FABRIC.—W W MAYER, 104 Walker St., New York, N Y

DESIGN FOR A HANDLE FOR TRAYS OR SIMILAR ARTICLES.—A HARCHOFF, c/o Eastern Metal Spinning Co, 467 Greenwich St., New York, N Y

DESIGN FOR A STONE SETTING.—A FRANK, 88 Nassau St., New York, N Y

DESIGN FOR A RIBBON CLASP.—S BRUNER, 64 Fulton St., New York, N Y

Miscellaneous Notes

Cat-Skins for Faceache.—Cat-skins have long been sold by French pharmacies as a sovereign remedy for faceache, and puss brings a much higher price since the war

Pushball Played with Fire Hose.—At a British carnival in aid of a local hospital a new variation of pushball was greatly enjoyed Opposing teams of firemen directed streams of water against the ball. It is to be hoped that the spectators wore waterproof clothing

For Better Packing.—Last November was "Perfect Package Month," during which railroads, steamship lines and express companies united in an attempt to impress upon the shipping public the need for good packing and the way in which it would improve the transportation service of the country

The Passing of the Moat.—The ancient moat, though picturesque, breeds disease The big ditch around the Tower of London has long been drained now the Bishop of London has filled up the moat at Fulham Palace, arousing the indignation of the Society for the Protection of Ancient Buildings.

Heligoland's Transformation.—When a syndicate of American and German capitalists finish waving the magic wand over Heligoland, the former grim wasps' nest will assume the aspect of a most attractive bathing resort, with a winter hotel, and a casino offering every facility for polite gambling. It is intended that Monte Carlo shall feel the competition

Friends in London.—The stranger in London may now go to any one of 750 friends for comfort and advice. The General Omnibus Company has stationed an inspector at each important traffic center, who is especially trained to give any information regarding the way to get about the city Look for the dark blue serge uniform and the cap badge with the initials "L. G O C."

On the Track of Treasure-Trove.—An old parchment in Italian has been found at Bisceglie, in the Province of Bari, Italy, telling of buried treasure supposed to have been hidden by a Roman matron at the approach of Hannibal's troops in 216 B.C. The treasure is particularized as consisting of 170 costly vases filled with gold and silver coins, antique works of art, jewels and pearls. The engraved stone indicating the place of concealment is said already to have been found

An International Language.—Our representatives before the International Research Council in 1919 urged the desirability of publishing an international abstract journal of chemical literature. Language was the stumbling block. A committee of investigation recently reported to the British Association They had considered three types (1) A dead language as Latin, (2) A national language as English, (3) An invented language, like Ido or Esperanto. Their conclusions were that Latin is too difficult, that the adoption of any national language would confer undue advantages and excite jealousy, and that therefore an invented language would be best.

Historic Trees.—Among trees recently nominated for the Hall of Fame for Trees by the American Forestry Association is the "Witness Tree" of the Donegal Presbyterian Church, in Pennsylvania. Its history is known for the past 200 years. Two others are an oak and a willow associated with George Washington, the first on the Hampton plantation, South Carolina, where Washington visited and admired it, the second at Constantine, Mich, grown from cuttings from the large weeping willow over the tomb at Mount Vernon Another nomination is the Lewis Cass elm at Elyria, Ohio. This is probably the oldest, for it has stood for at least 250 years.

Foreign Commercial Laws.—The Department of Commerce is compiling a comprehensive survey of commercial laws in foreign countries. Some years ago a partial investigation of a similar nature resulted in the publication of a few monographs dealing with certain countries. The present plan goes far beyond this, and will have a topical arrangement. The subdivisions are (1) General laws on the conduct of business, (2) Agency laws, (3) Sales contracts, (4) Bankruptcy laws and practice, (5) Bills of exchange, and (6) Commercial litigation, court procedure, etc. Far from having the object of eliminating the lawyer it will, on the contrary, place valuable data at his disposal, enabling him to serve his clients with greater efficiency.

Science Notes

A Digest of Everything of General Interest Appearing in Current Literature

Darwin's Birthplace.—Mount House, Shrewsbury with the famous Darwin Walk, a wooded promenade high above the Severn has been bought by the Office of Works to house its clerks

Lightning Cooks a Potato.—While a Pennsylvania housewife was paring a potato lightning melted the aluminum knife and cooked the potato to a turn To the accidental position of her hands at the time she probably owes her life

Prof. Nernst Wins Nobel Chemistry Prize.—Prof Walther Nernst of the University of Berlin is awarded the Nobel Prize for 1920 in chemistry by the Swedish Academy The prizes in chemistry and physics for 1921 are being reserved.

Fossil Forest.—The discovery of a fossil forest is reported at Anglon Sardinia. Petrified palms with well preserved structure are already known from a Miocene formation in the island and details of the new find will be awaited with much interest.

Weather Ten Days Hence.—Forecasts recently issued by the British Meteorological Office predicted 10 days of fair weather probably a record for long distance weather prediction in England No doubt wireless figured largely in this innovation which if found to be tolerably reliable, promises much for the agriculturist and others.

American Association Exhibits.—The Toronto meeting of the American Association will be marked by an exhibit of scientific apparatus The University of Toronto will provide space and exhibits of non commercial institutions and private individuals will be exempt from the small charge made to commercial organisations to cover expenses.

Paris Looking for Radium.—The Board of Charities of Paris is looking for one and a half grams of radium for free use in cancer cases No such quantity is available in France and as England has acquired all Czecho Slovakia's reserve much of the 2000 francs allotted for the purchase will doubtless go either to the United States or to England

To Fly to the Pole.—When Amundsen sails northward next May he will probably take along two airplanes and two aviators. He is himself an expert aviator His idea is now to fly to the pole which may indicate an abandonment of the plan to drift across with the ice pack The expedition is financed by the Norwegian Government and the schooner Maud now at Seattle is the center of busy preparations for the coming attempt.

A Coffin of Stalagmite.—Dr Hrdlicka of the National Museum was called to the Loray Caverns of Virginia to investigate some bones that had been discovered embedded in a stalagmite With some difficulty the whole deposit containing the bones was removed in pieces and the bones were found to be parts of a human skeleton but the only trace of the skull was a portion of the lower jaw The Museum is studying the specimens

Beheading a Palm.—The big Brazilian cocoanut palm in the New York Botanical Garden acquired the glass breaking habit Although the central dome of Range 1 in the Conservatories is 90 feet high the ambitious palm has several times poked its head through the top Taking into consideration the high cost of glass and labor this expensive habit had to be checked and the verdict was decapitation for the tree It had previously outgrown its quarters in the Central Park greenhouses

Photographing Fossils.—A contributor to *Science* suggests some improvements in photographing fossils. He places a dull white background some distance behind the whitened specimen turning this background at such an angle that it receives the full light but does not reflect it toward the camera. A screen, consisting of two or three thicknesses of cheesecloth on a wire frame, is placed between the specimen and the source of light. Every feature of the fossil is thus brought out.

Ruins of Incredible Age.—Are we on the brink of a revelation of life in the iron and bronze ages? Excavators in the ruins of an ancient village near Rome uncovered several two room structures of marble, granite and concrete. The metal implements and weapons found seem to indicate an age much more than 50 centuries. There are some who believe the hills around Rome contain remains of every stage of civilization, and that the original founder of the city may have occupied one of these buried villages

Standard Meter Lengthens.—In 1889 20 nations decided to take their standard of length from a platinum scale now France, the jealous guardian of this piece of metal, is alarmed to find that it has lengthened by a demimicron or five millionths of a meter The only explanation available is that the annual cleaning of the bar may have been responsible for displacing the platinum molecules. It will be carefully watched for the next ten years and the cleaning may have to be abandoned

The Making of Mummies.—Dr Edmond Bartha of Paris, who has for many years studied Egyptian mummies from the chemical point of view believes he has discovered an embalming fluid that will maintain a lifelike appearance in corpses for from 20 to 50 years. He holds that his fluid is similar to that used in the time of the Pharaohs but whereas the incisions were then made through the carotid artery femoral incisions are used in the new practice The long lost secret may have been found

Paris Geographical Society.—The Geographical Society of Paris celebrated its centenary in July last. Having been founded in 1821, it is the oldest geographical society in the world and nine years senior to the Royal Geographical Society In commemoration of the event the society has devoted an enlarged number of *La Géographie* (July August) to a history of the society and a record of the centenary celebrations. From the year of its foundation under the presidency of the Marquis de Laplace the society has grown in usefulness and influence

Orchid Facts.—It has been wrongly assumed that orchids are parasites drawing their sustenance from the trees to which they fasten Really they live almost entirely upon air The development of these fantastic flowers has lately received a great impetus in America due to the law requiring imported stock to be used only for propagating new plants and improving old varieties instead of being sold outright King Leopold of Belgium probably did more than any other man in the development and culture of orchids

Red Snow in America.—Last summer this phenomenon made its appearance in the Rocky Mountain National Park, to the wonder of tourists The great masses of color present in the snow fields of the higher elevations are due to billions of tiny organisms half plant, half animal that have the power of movement, growth and reproduction The organism is an Arctic species known as *Protococcus nivalis* and it has been found in Glacier and Mount Ranier National Parks only within the past decade. The color reaches its maximum density about a quarter of an inch below the surface of the snow on the tongue its flavor suggests watermelon. It is a mystery how the spore traversed such great distances, but it is supposed to have traveled on the Chinook winds.

Criminal Carelessness.—Five million vacationists take to our national forests every season In the four years 1916-1920 56,488,307 acres of forested area were burned this is more than two and a half times the area Germany lost by the war. A very large number of these fires are directly due to the thoughtlessness of tourists, a discarded cigarette stub, a campfire not properly extinguished, and acres of valuable timber that has taken generations to reach its splendid maturity are swept down in flames. The Forest Service wants the public to enjoy the forests; it builds fine roads and sets up free camping grounds for them. Is it too much to expect that in return they will be more careful with their cigarettes, and see that their campfires are thoroughly extinguished?

Miscellaneous Notes

Aerial Map-Making.—Aviators attached to the McCook Field are mapping the Mt. Washington region from an altitude of from 8000 to 10,000 feet.

Workers and Dirty Windows.—English tests showed that factory hands gained from 5 to 15 per cent in efficiency after the factory windows had been cleaned.

Moving Australia.—Checking by radio with time-clocks in France reveals, so authorities say, an error of 100 yards in Australia's latitudinal position on all maps. We may have to move Australia—on our maps.

German Conscience Works Slowly.—The Germans have at last returned the ancient astronomical instruments stolen from Pekin in 1901, among them the earliest known example of equatorial mounting, made about 1279.

Our Fight Against Leprosy.—The chaulmoogra tree of Siam and Burma, which yields the oil successfully used in the treatment of leprosy, is being introduced into this country A permanent supply of the oil is assured.

Orangeade without Oranges.—Only 10 per cent of this decoction is the real fruit juice; for the rest, we find orange oil, citric acid and coloring matter Such is the finding of Dr LaWall, the State chemist of Pennsylvania.

What Is Your Lawn-Mowing Record?—Why should sport have a monopoly of "records"? A lawnmower meter may now be purchased in New York registering not mileage but footage. Already a suburbanite is boasting that he has exceeded the record of his nearest competitor by 10,000 feet

New Radium Deposits.—A Belgian mission sent to the Katanga district of the Congo is said to have found extensive radium-bearing deposits. During the war a Belgian sold in London colcolite rich in radium. He refused to divulge its source, but the Belgian Government immediately instituted a search that led to the Katanga country.

Machines Increase Wages.—In the United States, as compared with Great Britain, our nearest competitor, says *Machinery*, production per man is 2.6 times as great, the output per man is twice as great, and wages correspondingly higher The cause is found in the fact that we use three times the mechanical horsepower per worker that England does.

Leather Made of Explosives.—The latest exploit of Henry Ford is to buy 35,000,000 pounds of deteriorating cordite gunpowder at one-fifth war-time quotations, and use it for making artificial leather Besides halving the cost of leather, of which 25,000 square yards are turned out daily, this also releases for other purposes more than a million gallons of benzol annually.

Chimney Efficiency.—A round chimney, while not so easy to build as a square one, has decided advantages over the latter It greatly lessens the friction between the walls of the chimney and the rising gases, and has the smallest wall surface in proportion to the cross area. The efficiency of a round chimney 24 inches in diameter is almost as great as that of a square chimney 24 inches across

Victims of Peace.—As a destroyer of human life the war, with its record of 48,000 American dead, is pressed hard by our industries, which claimed 85,000 victims in the same period of nineteen months On September 4, Labor Sunday, the subject of the responsibility of the Church in industry was taken up in our pulpits at the suggestion of the Federal Council, with a view to awakening interest in the safety of those who tend our high-speed machinery and shoulder the risks that, inseparable from such occupations, may yet be greatly reduced by proper methods.

Removing Ink Stains from Negatives and Prints.—It is not often, remarks a correspondent of the *British Journal of Photography*, that a negative or print is damaged by ink. A quick solvent is sulfuric acid. It should not be used stronger than one part in four of water, and if diluted from a concentrated fluid great care should be taken to pour the acid into the water and not vice versa. At the strength of one in five the acid is safe to fingers and photographs, and will remove ink without injury to [illegible] or silver. There is no need to [illegible], a spot or two applied with a small brush should be sufficient. A short washing afterward is necessary.

Metal Case for 1" Starrett Micrometers

Many appreciative users of fine Starrett micrometers have expressed a desire for a micrometer case rather more highly finished and substantial than ordinary micrometer cases, and adapted to carry 1-inch size micrometers—this, *of course*, being the size in greatest use

To meet this demand The L. S Starrett Company now offers a very handsome metal case finely nickel-plated, lined with black velvet and made to accommodate a Starrett micrometer of the above size, with adjusting wrench. The case has neatly rounded corners and is very compact: Outside dimensions are approximately 13/16 inch thick, 2¼ inch wide and 5½ inch long. Weight about 7 ounces. An illustration, showing the neat appearance and arrangement of this case, can be seen in the new Starrett Supplement to Starrett Catalog No. 22, copies of which may be obtained without cost from The L. S. Starrett Co , Athol, Mass.

New Micrometer Depth Gage with 1" Screw Added to Starrett Line

Numerous mechanics favoring a depth gage having a 1-inch movement of the screw will welcome the recent addition of such a gage to the Starrett Line The new Starrett gage—Starrett Micrometer Depth Gage No. 440—is designed to measure the depths of holes, projections, etc., from 0 to 3 inches by thousandths of an inch. With each Gage is included three measuring rods having hardened and lapped ends The rods can be easily and quickly inserted through a hole in the screw and brought to a positive seat by a small knurled nut

This Gage is supplied in two types differing in the length of base No. 440-A has a 2½ inch base, and No. 440-B has a 4 inch base. Thickness of base is about 4/10 inch. Bases are hardened, ground and lapped. Gages are furnished with or without cases.

These Starrett No 440 Micrometer Depth Gages are illustrated and described, with other new Starrett Tools, in a special Supplement to Starrett Catalog No. 22. Copies of this Catalog and the new Supplement will be sent without charge to all interested parties by The L. S. Starrett Company, Athol, Mass.

Civil Engineering Notes
Abstracts of Important Recent Papers and Published Articles

Process Metal Roofs.—The wearing qualities of a new process metal material for roofs, siding and trim have attracted considerable attention. This process metal is built up on a steel basis. Three impervious coatings are applied—namely, asphalt, asbestos, and waterproofing. These coatings envelop the sides, edges and ends, and make it impossible for destructive elements to reach the specially annealed steel core.

Electrification of Italian Railways.—From Consular sources we learn that the Director General of the State Railways of Italy is suggesting that the Italian Government have the reparations account settled in part by requiring the Germans to hand over material which could be used in electrifying Government railways. The office of the auditor general is said to oppose this means of settlement and to consider it preferable to have the adjustment of reparations made on a strictly money basis.

An Unusual Test for an Arch.—A reinforced concrete arch of 86 feet span, forming part of a highway bridge constructed the year before last at Herkimer, N. Y., was submitted to an unexpected and severe test when the work of concreting had been completed only 12 hours. Owing to heavy rains during the deposition of the concrete, the water in the river spanned by the bridge rose about five feet, washing out or undermining the supports of the centering and carrying away part of the latter to such an extent as to leave the arch entirely without support, save that afforded by the molds in which the concrete had been deposited. Notwithstanding the sudden strain so imposed on the concrete, no injury was caused in any part of the arch.

Britain and the World's Ships.—About 62.7 per cent of the world's shipbuilding is being done in British shipyards, according to *Commerce Reports*. Of this amount nearly all is in the United Kingdom, yet there is serious depression in the shipbuilding industry. Of the 3,500,000 tons of shipping now building 2,750,000 tons are almost completed. Only about four months' full time work is in sight and very few orders are coming in. The tonnage on which work has been suspended was 731,000 on October 1, and tonnage delayed in completion was 457,000 tons. These two items total 36 per cent of the amount under construction. Work on Britain's four latest post-Jutland battleships has been suspended in support of the limitation of armaments conference.

English Articulated Trains.—An articulated train put in service recently by the Great Northern Railway of England, consists of five cars mounted on six four-wheeled trucks, there being a truck at each end and one under each of the short vestibuled connections between the cars, according to *Engineering News-Record*. A 40-foot kitchen car is at the middle of the train with a first-class 45-foot dining car and a 55-foot coach at one end and a third-class dining car and coach at the other end. All cooking is done by electricity. This train is for a four-hour run between London and Leeds, making a round trip daily. The purpose of the design is to reduce dead weight. Thus, the train is 246 feet long, accommodates 128 passengers and weighs 118 tons on twelve axles. The ordinary train previously used consisted of four cars 60 and 65 feet long, of which the two dining cars (with kitchen in one car) had six-wheel trucks. This older train was 256 feet long, accommodated only 110 passengers, and weighed 180 tons on twenty axles.

Deepening the St. Lawrence.—A statement issued by the Deep Waterways and Power Association previous to holding its annual meeting at Hamilton, Ontario, recently, points out that "the deepening of the St. Lawrence River channels and the enlargement of the canals so as to permit ocean vessels to enter and navigate the Great Lakes is a matter of vital importance to Ontario. At this time when the continued high freight rates are recognized as the principal obstacles to a reduction in living costs the benefits that would result from a through water rate from European points to Great Lake ports cannot be overestimated. "When it is remembered that engineers of the Governments of Canada and the United States have reported that the improvement of the St. Lawrence waterways and the development of an initial block of electrical energy totaling 1,460,000 horsepower can be carried through for an expenditure of $252,000,000, and that the sale of the power will finance the entire undertaking, it will be realized that the fulfilment of this splendid project is much nearer than most people realize," continues our authority.

Sweden's New Locomotives.—There is marked activity on Swedish railways at the present time. Heavier rails are being laid, stocks of ties creosoted, and additional improvements are being planned for 1922, as a means of solving the unemployment problem. The German motor locomotives of the large, heavy type have recently been put in operation in the passenger service of the State railways. Perhaps the most important development in southern Sweden has been the completion of the largest Diesel motor locomotive in the world—the fourteenth car of this type built in a Swedish factory. The locomotive is driven by a 250-horsepower electric type Diesel engine making 500 revolutions per minute, and can draw four heavily loaded Pullmans at 60 miles per hour. Only one man is required to operate it, and in a trial run of 590 kilometers the fuel cost was less than 20 cents per mile, demonstrating the economical possibilities of this type of car. Satisfactory tests of a new type of steam turbine have been completed, and the engine is said to be so superior in design and construction and economical in operation as to warrant the statement that it will rapidly replace those now in use.

Our Building Activities.—From the civic development department of the Chamber of Commerce, which has recently made a survey of building activities in cities of over 25,000 inhabitants, we have obtained some interesting figures regarding building activities in 1920. Complete and partial reports were received from 181 cities representing a total population of 30,000,000. In 1920, 70 per cent of the families provided for got one-family dwellings, 11 per cent, two-family dwellings, and 19 per cent, apartments in multi family dwellings. It is also shown that the proportion of multi family dwellings that were provided in 1920 was largest in the small cities which have not had as much experience in this type of habitation. More house building in proportion to population was found in the smaller than the larger cities. Of the estimated $1,048,000,000 spent on buildings in 1920 in the cities reporting over 36 per cent was devoted to dwellings. Factories and workshops came second with 16.8 per cent, stores and mercantile buildings third with 13.8 per cent, while office buildings and garages tied for fourth place with 8.2 per cent each. Schools, hospitals, and charitable buildings together called for an expenditure in excess of $77,000,000.

Poured Concrete Houses in Germany.—A novel method of constructing concrete buildings has been developed in Germany. The basic principle of the method is the molding of complete houses with lean slag concrete, poured in at the highest point of the erected forms. Forms are made in standard parts from wood, and can be used up to twelve times. They can be erected either for the whole building, or in sections of from one to two floors. The mechanical qualities of the concrete thus obtained have been made the subject of extensive tests by the material testing institute in Berlin, according to *Engineering News-Record*. The erection of the forms, the molding, and the removal of the forms for one four-family house of two stories, continues our authority, has occupied twelve to thirteen days, including six days for the setting. Nineteen workmen were employed on this building for six to seven days. The concrete of this mixture is a bad conductor of heat, and therefore keeps the rooms warm. It is further claimed that nails can be driven in without using dowels, and that it is soft under the chisel, which facilitates plumbing work. The costs for a building of the size mentioned are around 40 per cent below those of a brick building of corresponding size.

Classified Advertisements

Mechanical Engineering Notes

Torch Used Under Water.—French naval men have improved the oxy-acetylene torch so that it can be used under water A small bell-shaped vessel surrounding the flame is kept supplied with compressed air the torch may then be plunged into water without going out. Should it become extinguished by accident the diver need not ascend to relight it. On removing the cap from an attached tube containing an alkaline metal and an oxidiser the chemical action of water on the mixture produces a flame that relights the torch

Germany's Hydro-Electric Plans.—Due to the remarkable utilization of her brown coal deposits, Germany so we have believed for quite a while, has not had to turn to hydro-electric developments for want of power However we learn from a recent issue of *Zeitschrift des Vereines deutscher Ingenieure* that such is not the case Germany is beginning to consider hydro-electric developments quite as ambitious as those being planned in other countries Plans are under way to harness available water power in various parts of the Republic not only for hydro-electric purposes, but for irrigation and better water transport as well

European Machinery.—We are in the habit of looking upon Europeans as being far behind us in the matter of mechanical equipment and manufacturing process We point with pride to our conveyor systems industrial tractors, automatic lathes, battery drill presses, elevator trucks, and so on and talk about our quantity production methods as if all of these things were unknown to the French British, and German manufacturers. In preparing some of the material for this department we have waded through a number of British, German and French industrial journals, and we find page after page of advertisements on all manner of equipment, ranging from the modest industrial truck and tractor to the electric crane Europeans have much the same equipment as we have, and their methods are more and more partaking of our quantity production idea. The Europeans call this idea the American system of manufacture or manufacture in series. What with lower wages, longer hours, the low rate of exchange and other factors, the European industrialists now that they have equipment comparable with our own, can be expected to give a good account of themselves in the international markets

Metal Fatigue Under Repeated Stresses.—The development of the internal combustion engine, the steam turbine the automobile, and the airplane has made the study of the fatigue of metals of increasing importance Much information relating to this subject was given in a paper by H F Moore and J B. Kommers, recently read before the American Iron and Steel Institute. The failure of machine parts under repeated stress has come to be commonly spoken of as due to "fatigue" of the metal The cause of such failure was at one time thought to be the "crystallization" of the metal In the paper referred to it is shown that the phenomenon is one of a breaking up of crystals rather than of their formation

The accompanying table which gives some idea of the number of repetitions of stress in the normal life of various structural and machine members, was prepared by *Machinery* from the data supplied in the paper referred to

RESULTS OF STRESS TESTS

Part of Structure or Machine.	Approx No of Repetitions of Stress in the Life of the Structure or Machine
Railroad bridge, chord members	2,000,000
Elevated railroad structure, floor beams.	40 000 000
Railroad rail, locomotive wheel loads	500 000
Railroad, rail, car-wheel loads . .	15 000,000
Airplane engine crankshaft.	18,000 000
Car axles	50,000,000
Automobile engine crankshaft	120 000,000
Line shafting in shops .	300,000,000
Steam engine, piston-rods, connecting rods and crankshafts	1,000,000,000
Steam turbine shafts, bending stresses .. .	15,000,000,000
Steam turbine blades.	2[illegible]0,000,000,000

Notes and Queries

The Notes and Queries column is maintained for the benefit of our readers who desire information on subjects germane to the scope of the paper, together with technical formulas and similar information. Matters requiring profound research or searches in a library cannot be undertaken. In connection with Notes and Queries proper, we maintain a "Service Bureau," which is able, in nearly all cases, to supply addresses of manufacturers whose articles have sufficient novelty and merit to be illustrated in the news pages of this periodical Correspondents are requested to write their inquiries in all cases, making the subject of the letter entirely separate from the correspondence relating to patents, subscription, books, etc This will greatly facilitate the answering of these questions, which in many cases have to be referred to experts. The full name and address should always be given. Our full "Hints to Correspondents" will be gladly mailed on request. All letters are answered by mail and only a very few of them can be printed in the limited space at our disposal.

(14883) G C. G says I would like to know just how ice skates should be filed or sharpened and (2) how fastened to the shoes to get the best results. (3) If you can give me any information about the proper care of skates I will be grateful. A (1) When skate blades have become dulled or chipped, or otherwise injured, they should be reground by competent workmen who understand about the proper grooving of blades. When regrinding, the blades should be emeried and oil-stoned, thereby avoiding the burr which gives the feeling of sticking to the ice. When sharpening tubular racing skates first use a coarse stone to grind blades straight and finish up on a fine stone. This makes a perfectly flat surface on the blade and a nice keen edge. (2) The best recognized practice for attaching ice skates to shoes is to set the skate so that the runner centers on the ball of the foot and the heel If a person's ankle is weak it is advisable to set the skate slightly off center on the weak side—still keeping the skate in a straight line with the foot. (3) Special care should be given to the skates, especially at the close of the skating season The foot plates and blades should be carefully rubbed off to prevent rust, and a coating of oil or vaseline applied, otherwise they will not be in condition for immediate use at the beginning of the next season

(14884) B R T says Christmas is coming and I want to make some sham snow for Christmas tree. A The cotton frequently used on Christmas trees to give the effect of snow is extremely dangerous. The very best substance to be used for this purpose is pure white "mineral wool"—i e., asbestos, when this can be obtained. Otherwise the cotton should be rendered incombustible, and this object, it is said, can be attained by saturating the cotton with a saturated solution of sodium tungstate You can buy artificial snow very cheaply Some of the varieties we have seen appear to be only ground mica.

(14885) A. S says 1 Does cloth, glass, copper and steel retain their tensile strength at a temperature of absolute zero? If not in what proportion do they lose it? 2 Does the contraction of metals which is fairly constant at ordinary temperature hold good when absolute zero is reached? 3. Is any known gas able to penetrate glass or a metal plate? 4 If we imagined a body able to attain the velocity of light in vacuum, would the ether offer any resistance? 5 If we imagined a human being located on such a body would he be able to "see" anything of what is behind him, ahead of him or at right angles to such motion? 6. In sending wireless signals "around the earth" does it travel around the earth or through it? A. 1 Metals are greatly increased in tensile strength by cooling to low temperatures. Probably this increase of tenacity would continue to absolute zero, although nothing has been cooled to absolute zero. That temperature has never been reached. The melting point of helium, the last gas to be solidified, is given by Olsen, *Chemical Annual*, as -269 C This is 3 degrees absolute. About cloth and glass we have no data. 2. We have no data for the contraction of metals at very low temperatures. See answer above for absolute zero on this matter. 3. Hydrogen will penetrate red hot cast iron As to glass, we do not know any case of such penetration. 4. We have no facts bearing upon the effect of

ether upon a body moving with the velocity of light. The motion of light is a wave motion and not a motion of translation of a material body No known body is moving with the velocity of light. 5 Light from in front of your imaginary body would come with twice the velocity it has at present It would not affect the optic nerve as at present constituted We can not see by a vibration of half the wave length of light. At present vision ceases at a wave length of about 150 ten millionths of an inch. At half this wave length we could not see The eye can not appreciate twice this velocity or half this wave length Light from behind us could not overtake us, and hence nothing could be seen to the rear Light from either hand by aberration would seem to come from an angle of 45 degrees in front of its real course 6. Wireless waves in part follow the earth s surface and one-half of the wave is in the earth and one-half above the surface of the earth Another part goes off into space "The Principles Underlying Radio Communication" is a good book on this subject. It is one of the instruction books for the Signal Service, U S Army

(14386) J J McA asks When was coal first introduced? A Coal seems to have been used for fuel by ancient Britons but the first proper notice we have is that it was mined in Newcastle, 1233, forbidden to be burnt in England 1273. Nobility and gentry of London petition against use of, 1300 Not in general use in England until 1625

(14387) E W B, Jr, asks for a formula for dentist's molding wax A Stearine 25 parts, half soft copal, 25 parts talc, 50 parts carmine, 0 5 parts oil of rose geranium, 2 drops to 1 oz. Melt the rosin by the heat of a sand bath, and when slightly cooled add the stearine stirring constantly When this has melted add the other ingredients previously intimately mixed, and stir so that a homogeneous product may be obtained The adhesiveness of the composition may be increased or diminished by modification of the amount of copal. A more thorough blending of the color may be insured by dissolving the carmine in a little potash solution before mixing with the chalk

(14388) J B W asks When were iron cables introduced? A Hempen cables employed by British navy prior to 1811 when iron cables were introduced. First successful submarine cable between S Foreland and Sangatte 1851, first Atlantic cable established July 20-Aug 16, 1857

(14389) C M A. asks how the French clean and prepare bones for exhibition purposes. A. The curators of the anatomical museum of the Jardin des Plantes have found that the spirits of turpentine is very efficacious in removing the disagreeable odor and fatty emanations of bones or ivory, while it leaves them beautifully bleached The articles should be exposed in the fluid for 3 or 4 days in the sun, or a little longer if in the shade. They should rest upon strips of zinc, so as to be a fraction of an inch above the bottom of the glass vessel employed The turpentine acts as an oxidizing agent and the product of the combustion is an acid liquor, which sinks to the bottom and strongly attacks the ivory if allowed to touch it.

(14390) A. C N asks Who invented bleaching? A Invented by Dutch first bleach field in Scotland estab at Salton about 1730 intro into England 1768 Berthollet s discoveries with chlorine, about 1785 Tennant s patent, 1798 Mather's improvements, 1885

(14391) R. L. K. asks for principal dates in relation to exploration of the Antarctic regions A Land discovered in these regions by Capt. Biscoe Feb., 1831, by Capt. D'Urville, 1838. Principal expeditions to C E. Borchgrevink lands at Cape Adair Feb. 23, 1895, 2nd expedition equipped by Sir Geo Newnes, reached Cape Adair Feb 17, 1899 De Gerlache expedition, Aug 16, 1897 Mar 28, 1899, German expedition, under Capt. H. Ruser, Aug. 11, 1901, British expedition under Capt. Scott, Dec 24, 1901 Sept. 10, 1904, Dr Bruce's Scottish expedition, Jan., 1903-July, 1904, Dr Jean Charcot, French expedition, 1904-05 and 1908-10 Lieut. Shackleton's (now Sir Ernest) expedition, 1907-09, Dr David, with Mr D Mawson and Dr Mackay, found the S. magnetic pole to be at 72° 25' S. 155° 16' E. on Jan. 16, 1909, Capt. Amundsen's expedition, 1910, South Pole reached Dec. 16, 1911 Capt. Scott, British expedition, 1910-13. (Capt. Scott was found dead by a search party, Nov. 12, 1913.)

Patents and Trade-Marks

General Principles, Current Comment, and Interesting Decisions

Patent Law in Japan.—The patent and trademark laws of Japan have recently been amended and numerous changes made therein. Of interest in the first of these, which, briefly, is to the following effect. A patent is to be awarded to the first applicant instead of to the first inventor and in case there are two or more applications with regard to an identical invention, filed on the same day, a patent will be granted according to the terms of agreement between or among the applicants. When no such agreement can be arrived at the patent will be granted to none. In this way all provisions for interference proceedings have been abolished.

Patent Infringement After Decree Punishable as Contempt.—A patent right is a civil right, and violation of a patent right constitutes a civil injury for which the law provides compensation, in the form of damages. However under certain circumstances, infringement of a patent may be punished, in effect, as if it were a crime. Thus, violation of an injunction restraining patent infringement is contempt of Court and may be punished by fine, by imprisonment, or by both. A case of this kind was recently decided in the United States Circuit Court of Appeals of the Second Circuit, *Schey vs Giovanna*, in which it was held that a certain change on an infringing device, by a defendant, after a decree and injunction against him was merely colorable, and his use or sale of the changed device is therefore punishable as contempt of Court.

Trade-Mark "Mutt and Jeff".—The Supreme Court of the United States has rendered a final adjudication of the trade-mark rights in the title 'Mutt and Jeff,' as indicating the humorous cartoons originated by H. C. Fisher, and widely exploited and syndicated throughout the country in various newspapers. An effect of the decision is that the proprietary right to 'Mutt and Jeff' as characters is possessed by Fisher, the originator, and that decisions to that effect in the New York State Courts are binding. The Supreme Court awarded to Fisher the exclusive right to the reproduction of the characters which he originated, and adjudged the reproduction of these characters by others in effect to constitute unfair competition. The Court refused to entertain the contention of the defendant that Fisher could only copyright particular postures or statements descriptive of their exploits, or that the two characters as he had devised them had become public property.

Effect of Prior Interference on Issued Patent.—As a general rule, the declaration of an interference proceeding in the Patent Office causes no joy to either of the applicants or patentees involved. It usually means added expense and delay. But even an interference proceeding is not without its advantages. The Supreme Court of the United States in a recent, interesting decision (Hildreth vs. Mastoras, decided November 7, 1921), has pointed out one effect of such an interference, which is of interest: that the presumption of priority and novelty which arises from the granting of a patent must have greatly increased weight when the claim of the inventor is subjected to close and careful scrutiny under the stimulus of an interference contest. Furthermore, the rule has long been laid down, though not referred to in the above decision, that in the event of subsequent litigation based upon a patent previously involved in an interference proceeding a preliminary injunction will generally be granted one suing upon the patent, where the defendant is the losing party in the interference.

Trade-Marks and Trade-Names Distinguished.—A trade-name can be distinguished from a trade-mark in that the former is either a word or combination of words serving to distinguish a certain manufacturer or merchant and his specific merchandise, which word or words, although not capable of exclusive appropriation, nor registerable in the Patent Office as a technical trade-mark, will nevertheless be protected within certain limits by the Courts from general use by competitors through the doctrine of unfair competition, while, on the other hand, a technical trade-mark is capable of exclusive appropriation, can be registered in the United States Patent Office, and an infringer may be proceeded against under the provisions of the Federal Trade-Mark Statutes.

Such words, therefore, as 'Wanamaker," "Hygeia," "The American Girl," 'Flare Front," "Waltham," etc., are trade-names which will be protected by Courts of Equity, through the application of the law of unfair competition, while 'Kodak," "Coca-Cola," "Jell-O," etc., are trade-marks capable of Federal registration and infringers may be proceeded against directly under the provisions of the Trade-Mark Statutes.

Curtiss First to Invent Hydroairplane.—In a recent decision of great public interest, the United States Circuit Court of Appeals for the second Circuit has held that Glenn H. Curtiss, of airplane fame, was the first to invent a flying machine that could rise from and alight upon the water, and established Curtiss's right to a broad patent covering the hydroairplane. This decision reverses that of the lower Court, the United States District Court for the Eastern District of New York. The litigation grew out of an application for a patent, filed August 22, 1011 by Curtiss, who, during the preceding January had tested his so-called flying boat in the harbor of San Diego, California, in a successful flight with an air machine equipped with a boat like hull and with the wings buoyed with small pontoons. This was on January 26th, the same day on which one Janin filed his application for a patent. The case turned largely on the actual reduction to practice by Curtiss, at San Diego. The Court held that this reduction entitled Curtiss to the broad patent, as Janin's invention at the time of this test, and even later, when the application of Curtiss was filed, had not advanced beyond the theoretical stage. The Court said, *inter alia*: "The reason for this holding is that whatever Janin conceived prior to January 26, 1011 whatever experiments or models he made, it is admitted that the fruit of all that he had done was contained in the specification he then filed. If, therefore, that specification does not enable the man skilled in the art to construct, without further exercise of the inventive faculty, an operative hydroairplane, there has been no reduction to practice, constructive or otherwise."

The Condition of the Patent Office.—The unfortunate condition in which the Patent Office finds itself, because of enormous pressure of work and numerically inadequate personnel, is fortunately being given a great deal of publicity in newspapers and technical periodicals of the country. Various associations interested, such as the New York County Lawyers Association, the American Society of Mechanical Engineers and others, are exerting every pressure to expedite pending Congressional action to remedy this situation. As has been already stated in these columns, the Patent Office is nearly 60,000 cases in arrears. A large proportion of its trained staff has resigned to take up more lucrative work, and in the seventy years past, the pay of the Patent Office personnel has been increased *but 10 per cent*. Surely, this needs no further comment. Nor is it necessary to say anything in regard to the bearing of the work of the Patent Office on the industrial, commercial and economic life of the country. Certainly, there can be no governmental function of greater importance than that which is largely instrumental in fostering the development of invention and the protection thereof. Great pressure is being brought to bear to further the passage of the Lampert Bill in Congress, which will result in a complete reorganization of the Patent Office, and will provide a sadly needed increase in the salaries of its employes. Further, the very fact that this bill has the hearty endorsement of some two thousand members of the American Society of Mechanical Engineers, to say nothing of the rank and file of the legal profession, is indicative of the importance of the proposed legislation and its need.

Electrical Notes

Summaries and Excerpts from Current Periodicals

Electric Steam Generator.—In a paper recently presented before the American Electrochemical Society, Messrs. Lidbury and Stamps give a description of an inexpensive form of apparatus and its method of employment for generation of steam by means of alternating current at voltages from 100 to 500. This apparatus is particularly adapted to a plant which operates its own hydro-electric installation or purchases blocks of hydro-electric power and has available at times energy which it can use at little or no additional cost. Under such conditions considerable saving in fuel may be made by use of the electric boiler.

A Million-Volt Transformer of 1000 KVA capacity is being built by a leading electric company for its experimental laboratory at Trafford City, Pa. The windings of this transformer contain nearly 70 miles of wire. The transformer is built on the principle of distributing the electrostatic stress as developed by C. L. Fortescue of the Westinghouse Company some eight years ago. The terminal bushing is the largest ever built in the Westinghouse shops. Special machines had to be fitted to turn the bushing on this account. Its length is 19 feet, and it is 41½ inches in diameter. The static shield will be 10 feet in diameter and 20 inches deep. The bushing will weigh about 9000 pounds when completed.

Valve Amplifiers in Cable Work.—Amplifiers of the valve or vacuum tube type are being applied to cable work, but no results have yet emerged, except for a solitary German note on the subject, so we learn from *The Electrician*. The capabilities of a modern amplifying device applied to a submarine cable are far in advance of the ability to take advantage of them. With supersensitive receiving devices the duplex balance requires refining to a degree which does not seem possible technically or commercially. Moreover a long submarine cable stretched from continent to continent collects disturbances not apparent on the ordinary siphon recorder, and we can only reckon on an increase of cable speed of about 50 per cent as a matter of routine, when such amplifiers are employed.

Telephone Cables and Amplifiers.—An interesting account of the history and development of the art of telephoning over long distances, through cables beginning with Professor Pupin's loading coils, their calculations and present use, is contained in a recent issue of *Electrotechnische Zeitschrift*. The Krarup system of increasing the inductance of a cable by winding a layer of iron wire upon the copper conductors is mentioned as the second step. This system is used, for example, on the long submarine telephone cable in East Prussia. Then came the Brown microphone amplifier, based upon the electromagnetic principle, but never used practically, as it was superseded by the Lieben amplifier in 1910, which was the forerunner of the vacuum tube, and finally the present-day high-vacuum electron tubes.

Electioneering by Radio.—For the first time in the history of electioneering candidates were able to talk to the public without the latter leaving their homes. This was done by means of the Westinghouse radio telephone broadcasting station at Pittsburgh, where the speeches were made by the candidates. The nominations for mayor proved a very bitter fight in Pittsburgh, and radio was called into play to get the messages of the candidates to the people. In this way thousands of persons were addressed at one time without the inconvenience of leaving their own radio set. Each candidate for mayor was sent to the broadcasting station, where he was allowed five minutes to tell the reasons why he should be elected to the office. This proved to be quite popular and excited no little interest in Pittsburgh and vicinity.

New Use for Electric Water Heater.—Still another type of electric hot water heater has made its appearance on the market, indicating the growing demand for devices of this kind. This latest type is not an instantaneous heater. The standard sized heater of this type supplies sufficient hot water and in large enough quantities (15 gallons per hour) for any household use with a maximum current consumption of 16 amperes. It operates on either alternating or direct current, 110 volts. Its operation is controlled by a three-heat switch, making it possible to regulate both the quantity of hot water and the temperature. The heating unit can be readily removed without the necessity of drawing off water from the tank. One ingenious application for this heater is in connection with hot water radiators, where one heater may serve to operate a single radiator in instances where it would not pay to start up the entire heating system.

New Uses for the Telegraphone.—In the telegraphone devised many years ago by Poulsen a telephonic conversation was 'fixed' by magnetic action upon a steel ribbon or a steel wire and could be reproduced later by passing this ribbon again over a small electromagnet in the winding of which a fluctuating voltage was set up which in turn energized a telephone receiver. The results obtained with this apparatus did not warrant its more general use, on account of the faintness of the reproduction. Since, however, the modern vacuum tube came into vogue it has been possible to amplify the sound to any degree and A. Nasarischwily in *Electrotechnische Zeitschrift* states that he has constructed an electromagnetic phonograph on the combined principles of the telegraphone and the amplifying tube. He shows further that with this method a message may be "spoken into" a rail and picked up by the engineer of the train following. Here is a suggestion that might be of great value for railway signalling purposes.

Something New About Batteries.—When storage batteries or dry cells are cooled down to minus 170 deg. C. the temperature of liquid air these producers of electricity may reverse their voltage. This is the scientifically startling phenomenon that has been discovered at the Bureau of Standards by G. W. Vinal and F. W. Altrup, who were making tests to determine the reliability of batteries at arctic temperatures. So far as is known, this is the first time this phenomenon has been observed. Down to 80 deg. below zero the voltage remained at the normal value. At about minus 100 deg. C. the voltage dropped down to nothing and then at a slightly lower temperature, strangely registered a minus reading as high as 10 volts. The voltage fluctuated violently ranging from positive 10 volts to negative 10 volts. These reversals happened whenever the frozen electrolyte of the cell "ticked." No hope is held out by the Bureau of Standards that storage batteries can be recharged by the simple method of cooling them to the low temperatures used in the tests. The currents at these low temperatures are vanishingly small, and practically they hardly exist.

Pilotless Warship.—A boat built by the French Navy during the war was controlled from an airplane. The construction of the control mechanism is described in a note appearing in a recent issue of *Electrical World*. This boat was patterned after a German pilotless boat which attacked a French pier. The German boat was driven by a gasoline motor and electrically controlled by means of a 30-mile one-conductor cable. The boat contained two gasoline motors such as are used on zeppelins, operating twin screw propellers capable of giving the boat a top speed of 40 knots per hour. Seven distinct operations of the engine and the rudder could be performed by means of the remote electric control. The control was essentially by means of a ratchet mechanism, a different number of ratchet impulses corresponding to certain actions of the boat. A small gasoline-electric generator set and a storage battery furnished the energy for the operation of the different motions. A special time relay was in series with each of the seven distinct positions, so that every one of the different operations was executed only after the contact-making ratchet mechanism stopped for a certain minimum time on a given position. In case of imminent danger to the boat an eighth position of the contact apparatus was provided for the self-destruction of the boat by ignition of its own charge.

The Last Word in Illuminated Highways

(Continued from page 97)

others' light The real trick about the assembly, after having got the focal lengths and curvatures of the several mirrors just right, lies in the relative position of the lamp, the rear cut edges of the mirrors, and their front cut edges. Reference to the sectional drawing will show that the lamp, the inner edge of the second mirror, and the outer edge of the first one are all in line. This means that the light which would pass outside the opening of the outer mirror and escape reflection altogether is that with which the central mirror works. And a similar relation exists between the second and the third mirrors. The inner reflector is of sufficiently narrow aperture so that the light that it "wastes" is not really wasted at all, it falls directly upon the road within the zone of illumination

Finally, in the bottom of each reflector as it hangs on the pole are cut rectangular openings of carefully determined size. It will be realized that none of the three mirrors throws any light to the ground in the immediate vicinity of the pole. The area between the pole and the commencement of the zone of illumination of the outer paraboloid is taken care of by direct light passing through the rectangular gaps, and these are made of just the right size to take care of this area without illuminating any of the region at the side of the road, and without overlapping into the territory of the large mirror

Two of these nests are joined, back to back, along the cut edges of the outer mirrors, with the lamp in the center The point where the lamp falls must, of course, be the common focus of all six paraboloids. The two inner mirrors are supported only by the cross-rods, which are seen clearly at the front in our photograph and less clearly at the back. The whole outfit is now hung from the pole on a universal bracket which permits of tilting the reflector up at either side so that it shall lie at the proper angle to a sloping road, swinging it inward or outward to meet a curve in the highway, and swinging it bodily a short distance up or down to dodge an obstacle which would otherwise throw a shadow on the road

That the reflector is really two reflectors joined is emphasized when it is viewed, lighted, from the road The nest of mirrors on the other side of the pole from the spectator turns its dark side, and this is unilluminated, so it is wholly invisible. One can hardly believe that the reflector is a two-sided one until one goes around to the other side of the pole, when the side he has been looking at disappears and the other springs into view From no point does the reflector give glare, it seems rather like one of those big diffused lights that are so easy to look at.

A trial installation has been made on several miles of the Albany highway out of Schenectady Owing to the extreme glare from trolley headlights, the high speed induced by the long straight road the tricky character of the roadside where blind culverts and fills encroach seriously, and the pleasant habit the residents along the way have developed of using the middle of the road as a promenade at all times and all places and under all circumstances, the road has earned an unenviable reputation as the scene of fatal accidents. The poles have been placed for the most part 400 feet apart. Little is gained where for experimental purposes they have been spaced 300 feet; but spacings of 500 and 600 feet show noticeable inferiority The lamp is an ordinary 250-candlepower affair, making the cost of operation little if any in excess of that of the customary ineffective highway installations. The lamps are attached to the poles at heights of 30 or 35 feet. They have been put on existing poles, so no serious effort to compare staggered settings with all-on-a-side could be made.

With these lights in operation the road is illuminated as I had never imagined I should see a road lighted. We extinguished our headlights completely and drove with ease. The road stretches out before the car in an unbroken ribbon of light—a ribbon of light lined with inky blackness that attests to the efficient concentration of the light where it is wanted. Anyone who will count the lights that are distinguishable in the accompanying photograph, and make due allowance for the characteristic dispersion on the plate, will have no difficulty in crediting my statement that by counting the lights ahead of us we could assure ourselves that in the absence of intervening hilltops a full half-mile of the road was at all times clearly visible. The concentration of light on the road was such that in some respects visibility was better than in broad daylight. I have my doubts, for instance, that in the daytime I could see a cat crossing the road half a mile ahead; or, seeing it, identify it as a cat without the possibility of error The feline to which I refer, under the conditions pictured, fairly leaped into the field of vision, and was not to be mistaken for any other animal. Rough places in the road far beyond the range of the ordinary headlight stood out clearly; cross ruts that would have thrown an alarming shadow in any other illumination I ever saw were shown in their true character 500 feet away The illumination is absolutely uniform, there is no suggestion of zones of light and darkness.

Such terms as "revolution" and "epoch-marking" are used far too freely in describing technical advances. But I can conceive of no reason why they should be withheld here. In the presence of this reflector there is no excuse for inefficient highway illumination. My pronouncement of several months back may be modified: a road should be illuminated by this device or a better one, *or left dark.*

The Heavens in February, 1922

(Continued from page 136)

southwest and Aldebaran high in the west. Capella, still higher and north of west, may be counted as a member of the same group, and so also may be Canopus, which is visible low on the southwestern horizon to observers in the Gulf States—though never in the north. Regulus is high in the southeast, and at our hour of observation Spica and Arcturus have just risen.

The Planets

Mercury is in conjunction with the sun on the 14th and is practically invisible except at the very beginning of the month, when he sets an hour and a half later than the sun.

Venus, too, is in conjunction—behind the sun, unlike Mercury, which is in front of him—and can hardly be seen in spite of her great brightness.

Mars comes into quadrature on the 20th. He is then in the western part of Scorpio and rises about 1 A. M. He is steadily approaching us, and is now brighter than the first magnitude, and gaining in light.

Jupiter is in Virgo and rises about 10 P. M. in the middle of the month. Saturn is in the same constellation, but further west, rising about 40 minutes before Jupiter

Uranus is nominally an evening star, but is too near the sun to be seen. He is in conjunction with the sun on the last day of the month. Neptune comes to opposition on the 4th. He is then in 9h. 8m. 20s. R. A., and 16° 34′ 32″ north declination, and is moving 6.7s. eastward and 30″ northward per day. This places him in the eastern part of Cancer, far from any conspicuous stars, so that an equatorial telescope or a good star chart will be required to find him.

The moon is in her first quarter at 11:52 P. M. on the 4th, full at [illegible] P. M. on the 11th, in her last quarter at [illegible] P. M. on the 18th, and new at [illegible] P. M. on the 26th. She is nearest the earth on the 12th and furthest away on the [illegible]. During the month she passes near Neptune on the 11th, Saturn on the 14th, Jupiter on the 15th, Mars on the 18th, Mercury on the 24th, and Uranus and Venus on the 28th. The conjunction with Jupiter is fairly close.

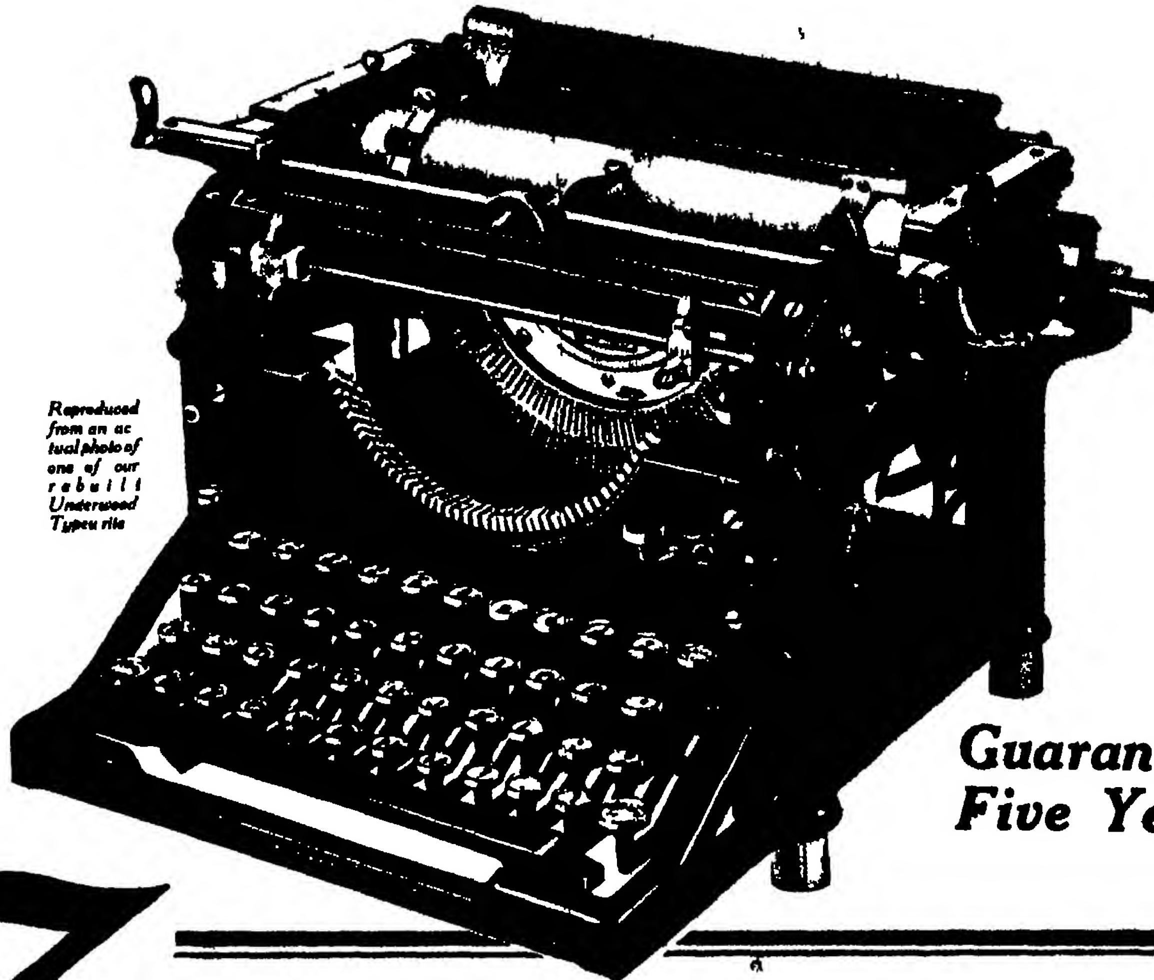
Nielsen Carbonization Process

IN view of the attention which has recently been directed to the production of smokeless fuel by low temperature methods of carbonization, it is of interest to note the introduction of a continuously operated mechanical process based on the principle of a revolving retort.

The system is the invention of Mr Harald Nielsen, who has combined with a slowly revolving retort a means for internal heating with an oxygen-free gas. As smokeless fuel is the primary object, the quality of the permanent gas ultimately obtained is not of any great importance; accordingly, internal carbonization is effected by means of hot producer gas. This is a decided departure from [illegible] in use and is [illegible] for the results, that, as [illegible]

SCIENTIFIC AMERICAN
The Monthly Journal of Practical Information
MARCH 1922 $4.00 a Year

PHOTOGRAPHER SIGNALING FOR A TURN AN INCIDENT IN AERIAL MAP MAKING.—[See page 157]



Reproduced from an actual photo of one of our rebuilt Underwood Typewrite

Guaranteed Five Years

$3 DOWN puts it in your home!

YES only $3 brings you this genuine Shipman Ward Rebuilt Underwood direct from our factory Then only small monthly payments makes it yours or, if convenient pay cash Either way, you get the world s standard typewriter and at a big saving to you

WHY PAY RENTAL?

Think of it You pay only a little more each month than rental—and the machine is yours! We offer you the same *four* models of the Underwood Typewriter that are being made and sold by the Underwood Company today The only difference is that Shipman Ward machines are rebuilt like new by experts You can t tell Shipman Ward Rebuilts from brand new machines Visible writing—the *full line* of typewriting is visible at all times *Standard 4 row single shift keyboard* Two-color ribbon back spacer, stencil device automatic ribbon reverse tabulator etc In addition we furnish FREE water proof cover and Special Touch Typewriting Instruction Book

EASY PAYMENTS

You pay only a little each month The amounts are so conveniently small that the machine will be yours before you know it And all the time you are paying you will be enjoying the use of and the profits from the machine

10 DAYS FREE TRIAL

Remember you don t even have to buy the machine until you are fully satisfied with it after a 10 days free trial See for yourself how new it is and how well it writes You must be satisfied or else the entire transaction will not cost you a single penny And you can earn liberal cash commissions on any machine sold through you. Ask about our Agency Plan

If you have an Underwood we will accept it in trade for a later model or rebuild it for you But tear out and mail the coupon now so you will be sure to get your Underwood at a big saving Act now—send the coupon today

All shipments made direct to you from this big modern factory the largest typewriter rebuilding plant in the world

GUARANTEED REBUILT Shipman-Ward UNDERWOODS

NO PAYMENTS IN JULY OR AUGUST!

FREE TRIAL COUPON

Typewriter Emporium 2183 Shipman Building,
SHIPMAN-WARD MFG CO CHICAGO

Please tell me, by return mail how I can get a genuine Shipman Ward Rebuilt Underwood in my home for only $3 down This is not an order and does not obligate me in any way

☐ Send me your cash offer ☐ Send me your easy payment offer
(Mark with a cross)

Name

Street or R F D No

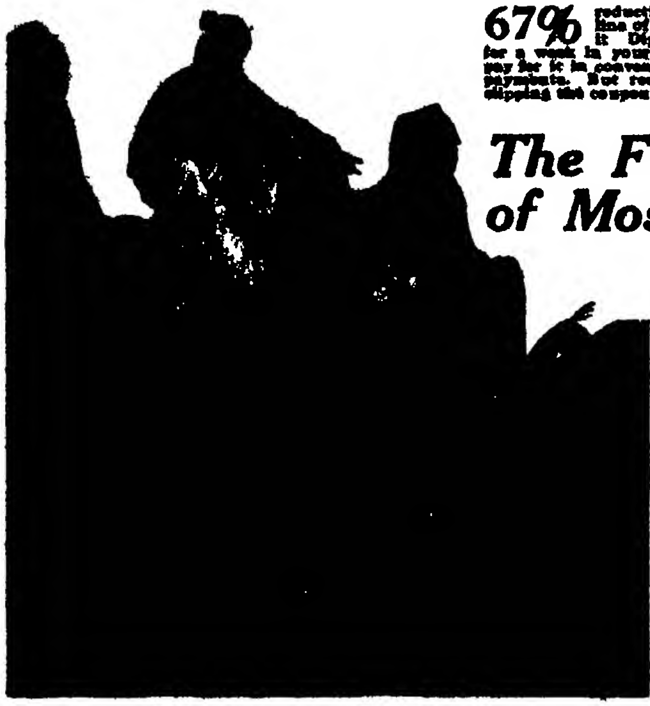
Post Office State

Mail Coupon Today

Typewriter Emporium
SHIPMAN-WARD MFG.CO

THE REBUILDERS OF THE UNDERWOOD *Also Manufacturers of the Lightning Coin Changer*

2183 SHIPMAN BUILDING, CHICAGO **Established [illegible]**



67% reduction on Wells Outline of History. Examine it. Dip into it. Keep it for a week in your own home. Then pay for it in convenient tiny monthly payments. But reserve your copy by clipping the coupon NOW—TODAY!

The Finding of Moses

ON a tablet dug up from the ruins of ancient Nippur was recently found a Sumerian inscription, detailing in almost identical words the Biblical story of the birth and finding of Moses

Written nearly 5000 years ago, centuries before the Scriptures were more than traditions handed down from father to son among the children of Israel it yet forms an almost exact parallel to the Scriptural narrative

This curiously interesting inscription is but one of the many thousands that have enabled scientists and historians to correlate the histories of the ancient peoples that lived and fought over and died in the land of Palestine in the times of Moses of Joshua and the Prophets Now translated into English and for the first time made easily available this and a thousand other stories of intense interest to every man are to be found in

H. G. WELLS' "Outline of History"

Now Offered You at One-Third the Original Price

A history that goes back 100,000,000 years—that traces man's rude beginnings 500,000 years ago—that follows him down through the prehistoric ages to the Babylon of Nebuchadnezzar, the Athens of Pericles, the Egypt of Cleopatra, the Asia of Genghis Khan, the France of Napoleon, the England of Gladstone, the America of today, through the Great War and on into the future United States of the World—that gives ALL history as one story—that is Wells'

The man who finishes this volume will be an educated man however much how ever little he knew when he started"—*Baltimore Evening Sun*

There you have it in a sentence—the reason why 250,000 men and women have paid $10.50 for Wells' Outline and felt they were getting it cheap The Outline is more than a history—it is an education—the orderly knowledge of human progress which men go to college four years to get—and often come away without

Voluntarily Wells has slashed his royalties 85% and entered into a contract with the REVIEW OF REVIEWS by which one edition of the Outline can be offered to Americans—to you—at a fraction of the former price

Think of it—the original plates and illustrations, but corrected by Wells himself and printed in one handy volume instead of two

This means we must get quantity prices on printing and paper, but it means, most important of all, that we

Must Know How Many to Print

Shall the edition be 50,000? Or 100,000? Or 200,000? We must know now

As the New Republic truly says "The Outline is too big even for publishers' superlatives." Without exaggeration, therefore, let us say very earnestly If you want the opportunity of examining Wells Outline *free* in your own home for a week do not lay this page down until you have made your reservation by clipping the coupon

And The Review of Reviews Too

For Thirty Years the Standard of Usefulness and Authority

Where Wells story leaves off the Review of Reviews takes up the record of human achievement His is the history of the past, the Review of Reviews records and interprets for you the story of today It is fitting that the two should be joined together, and only by joining them can we make the remarkable offer for details of on the coupon below

Am.

Review of Reviews Co.
30 Irving Place
New York City

Send me *on approval* charges paid by you Wells Outline of History in the latest revised edition *at the special price of $8.50* Also enter my subscription to the REVIEW OF REVIEWS for 1 full year at its regular price—$4.00 I will either send you 50c in 5 days and $1 a month thereafter for 7 months or I will return the Wells History within a week and send you 25c for the first copy of the magazine delivered and cancel this order (For the luxurious full leather binding add 8 more payments.)

NAME
ADDRESS
OCCUPATION

For full cash with order, send only $8.40

Review of Reviews Co., 30 Irving Place, N. Y.

A New Thrill—A New Pleasure

The Ace Four-Cylinder Motorcycle brings to you an entirely new idea of motorcycle transportation

This cross section drawing shows the remarkable refined design of the Ace four cylinder motor An exclusive pre heating device prepares the fuel for perfect combustion large valves insure ample gas and air supply and provide for quick complete expulsion of exhaust gasses from the cylinders compact combustion chambers with spark plugs firing in center of fresh gas give snappy ignition precision ground cylinders and pistons insure maximum compression large sized case hardened three bearing crank shaft ground to glass smooth surface minimizes friction long connecting rods reduce the angularity of thrust, adding wonderfully to the driving power

SMOOTHNESS that you have never imagined silence that you have never dreamt of and comfort that has never before been possible in a motorcycle belong to the owners of the Ace four-cylinder motorcycle

A steady flow of great power and silent vibrationless action come from Ace perfected four cylinder construction The real thrill of flying sweeping motion is yours the moment you mount this new Master of the Highway In stant pick up at a twist of the wrist comfort safety and speed that give you a new control over time and distance

Learn these things for yourself—go to the nearest Ace dealer have a demonstration of the machine whose beauty strength power and flexibility are giving its riders a transporation service never before available

If you do not know the Ace dealer send for illustrated descriptive catalog and we will refer you to him

ACE MOTOR CORPORATION Erie Ave at Sepviva Street Philadelphia Pa.

ACE

DEALERS
Limited territory is still open to a few responsible dealers Send for complete agency particulars

"Will a Vario Coupler and Crystal Detector Give Me Better Results with Radio Music?"

Since the popular acceptance of radio throughout the country many hundreds of requests similar to the above have come to the editors of Scientific American ranging all the way from wave lengths to vario couplers and vacuum tube detectors This countrywide interest in radio has prompted us to prepare a general book on the subject

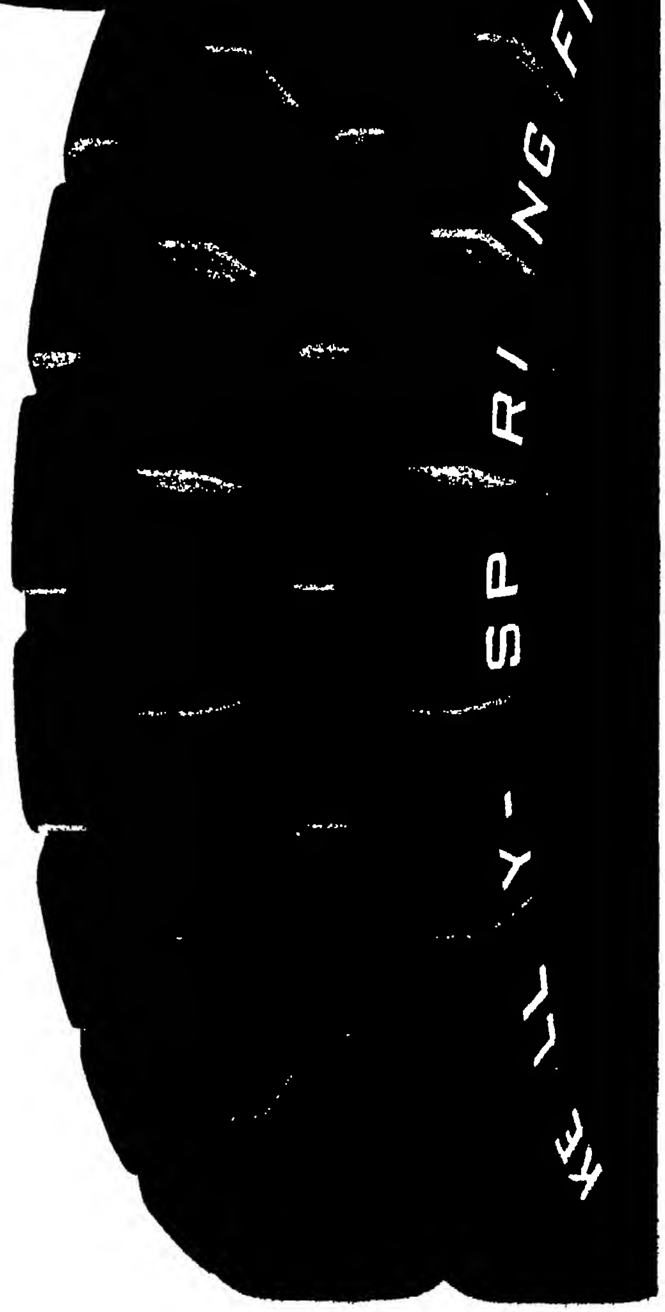
Scientific American herewith announces the publication of this book called Radio for Everybody It will embody all the principles and applications of everyday radio as applied at home and in business It contains over 380 pages and more than 100 illustrations bound in serviceable cloth

The keynote of this radio book is easily understood and easily applied It gives you accurate description of the various kinds of apparatus explaining which to use according to your needs and location it tells you how to make use of radio for entertainment in the home and at business it tells how to send as well as receive messages And it tells you how to master the telegraph code so as to understand regular radio traffic This book is complete accurate and practical—written in plain English for immediate application

Price $1.50 by mail $1.60 Radio for Everybody will be ready in March because of limited publication we urge you to send in your reservation order as soon as possible and it will be filled from the first edition

SCIENTIFIC AMERICAN PUBLISHING CO.
MUNN & CO.
233 Broadway New York City

Scientific American, March, 1922 Volume 126 Number 3. Published monthly by Scientific American Publishing Company at 233 Broadway, New York N Y Subscription price $4 a year. Entered as second-class matter June 13, 1879, at the post office at New York N. Y., under the act of March 3 1879



With the Editors

NOT the least interesting phase of magazine editing is the selection and preparation of the cover subject Perhaps it is the element of chance which makes this phase so interesting, or again it may be the natural instinct for making pictures, which is imbedded more or less deeply in all of us. At any rate, to select a suitable subject is by no means a simple matter, for when it comes to making a cover picture there are few subjects which readily lend themselves to such treatment And even a subject that seems most suitable and attractive not infrequently proves a disappointment in the finished form Here, then, is where the element of chance enters, which is due, in large measure, to the many steps between the inception of the idea and its realization on the printed cover First of all, a choice is made from among a selection of subjects. Our cover artist is given the idea, together with suggestions as to composition, details and color treatment The artist, being a rather particular sort of person, not infrequently insists on seeing the subject at first hand, and even makes his own photographs of the various details so as to ensure the utmost accuracy for his painting For instance, in making our November cover picture, Mr Brown, the artist, obtained his data and actually sketched his subject while riding behind the engineer in an electric locomotive In making the present cover picture, Mr Brown studied the airplane used in aerial photography work at first hand. The various data then take shape in a preliminary rough sketch, which is usually the object of some criticism and much suggestion The sketch incorporating the numerous changes and suggestions, is then transferred on to the large canvas, to be worked out in oil paint The finished canvas, after certain slight changes which may be necessary, is sent to the lithographers in order to be reproduced. The photographer, the plate maker the ink maker, the paper maker, the pressman—all of these are directly responsible for the carrying out of the cover idea in order that the finished result may be a success.

SEVERAL days after it became entirely clear that the Washington Conference would result in the necessity for destroying a number of American battleships, completed and under way, we had a visitor from Washington—a Naval officer He came to tell us his troubles and to ask us for help. This wholesale scrapping of tonnage was something new in the Navy's experience In brief, the Navy's state of mind was, "Well, how *do* you scrap a battleship?" It was desired that we give the widest publicity to the problem, and aid the Department in gathering data In exchange for ours we could have theirs, if we would promptly print the whole story We investigated, the Navy investigated, others investigated. As we go to press, the answer to the problem, so far as it has been worked out, is as we give it in our handsome center insert, which is reproduced by the offset process of printing

THIS issue is distinguished from preceding issues of the new monthly SCIENTIFIC AMERICAN by its several long articles. Always our policy is to keep our articles down to the smallest possible space, consistent with clear exposition of the subject and proper pictorial display It just happens that several unusual subjects came along in time for this issue "Winged Surveyors" is an interesting review of what is being done with aerial photography in these days of peace The author is none other than Sherman Fairchild, who has done so much for this branch of photography during the past year or two Aside from covering the technical features of his subject, Mr Fairchild has succeeded in introducing plenty of human interest which is always the spice of any story Then there is the article on the scrapping of battleships, which requires four pages for proper treatment "Radio for Everybody" is the long radio article which has been promised It is intended as a preliminary introduction to this most timely subject, and is to be followed by other more advanced and certainly more specific articles.

WHILE on the subject of radio, we might as well announce the big radio story for the April issue Several weeks ago various amateurs throughout the country participated in the transatlantic sending tests, and not quite thirty of the transmitters were heard in Scotland by a representative of an American radio organization There is real romance in these tests, as well as meat for thought. The Government and the commercial stations capable of spanning the Atlantic are using upwards of 100 kilowatts for the purpose, yet along come the radio amateurs with small aerials and less than one kilowatt of energy for the same purpose We have in mind a little shack outside of Greenwich, Conn., where a number of young men spent several long nights over their vacuum tubes and condensers, tuning coils and motor generators, sending certain code messages at predetermined times and wondering all the while if they were "getting through" But why tell the story here? This incident is only a small part of the article that will appear in the April issue

IN view of the conference between the Government and Henry Ford with regard to the disposal and the development of the Muscle Shoals engineering project, it is well to direct attention to the article on this huge undertaking which appeared in our issue of May 7 1921 In that issue we reviewed the engineering features of Muscle Shoals and the giant Wilson Dam, and to do so again would be but tiresome repetition However as Mr Ford's plans take definite form we shall have more to say regarding this gigantic work

JUDGING by the progress made in psychical research as well as the steadily increasing seriousness with which such work is being greeted by the thinking people of the world it seems but fair that a journal of this kind should at least devote a quota of its attention to the foremost developments in this latest science In this issue, therefore, appears an article on the human aura prepared by a member of our staff If we had been unable to see such a phenomenon for ourselves, we should be highly skeptical But in this article we speak from first hand experience and in all other similar subjects which we may treat in subsequent issues we shall make it a point to draw a very definite line between what we know from personal experience, to be so and what is reported to us by other persons. In some instances we shall therefore assume full responsibility for the statements made while in others we shall make it clear that the author of the article speaks for himself and not for us.

CONTENTS

MARCH, 1922

LEADING ARTICLES

SHORTER ARTICLES

DEPARTMENTS

SCIENTIFIC AMERICAN PUBLISHING COMPANY

Munn & Company, 233 Broadway, New York

Founded 1845

CHARLES ALLEN MUNN President ORSON D MUNN Treasurer
ALLAN C HOFFMAN Secretary

Vol. 126 No. 3 Published monthly Entered as second class matter June 18, 1879 at the post office at New York, N Y under the Act of March 3 1879

Price, 35 cents a copy $4 00 a year Postage prepaid in United States and possessions and Mexico, Cuba and Panama $4 50 a year for Canada Foreign subscriptions, $5 00 a year postage prepaid.

SEVENTY-EIGHTH YEAR

SCIENTIFIC AMERICAN

THE MONTHLY JOURNAL OF PRACTICAL INFORMATION

NEW YORK, MARCH, 1922

Winged Surveyors

What Aerial Photography Is Doing for Industry and Science

By Sherman M Fairchild

"NEW YORK will be a nice place when they get it finished"

Thus spoke Tacks, one of the delightful characters of the John Henry stories, expressing his contempt for the ever-changing New York, with its torn up streets, subway extensions, wrecked buildings and new ones taking their places, in ever recurring cycles.

In a manner of speaking, we have never until recently had a good look at the island our thrifty Dutch ancestors bought from the Indians. As for our poor ancestors, they never did get a good look at it In those days there were too many trees. In these days there are too many buildings

It takes an aerial view to give New Yorkers a comprehensive view of the town they live in, to make them comprehend fully the extent to which the trees have given way to the buildings, and the buildings to other buildings. And it is only recently, as remarked above, that we have been able to look down, get a bird's-eye view of the whole layout, and decide whether it was the Indians or our ancestors who drove the best bargain.

In the last six months, for example, the first complete aerial mosaic map of Manhattan Island has been assembled, and photographic prints are being made on a scale that brings out a wealth of interesting detail and opens up a vast source of information that will be useful in the further expansion of the city's commerce and industry and home building.

Oblique or Mosaic—Which?

Aerial photography of to-day has two distinctly separate forms as to method of production and application. There is the oblique or perspective view, which is of value in commerce and industry in diverse forms of advertising and sales field analysis. It is the most advanced method of giving a comprehensive illustration of a given area, showing in detail the character of buildings or industrial facilities of that area The other type of photograph is the vertical or mosaic photograph, which, in its complete form, is really a series of vertical photographs taken over an area and so matched together that they form an accurate photographic map from which scaled measurements may be taken These two phases must, in justice to the subject, be dealt with separately

The oblique, requiring less skill and preparation, *naturally preceded the vertical Its problems, when* solved, paved the way for the vertical and the development of the mosaic, from which the greatest benefits will undoubtedly be derived in the near future

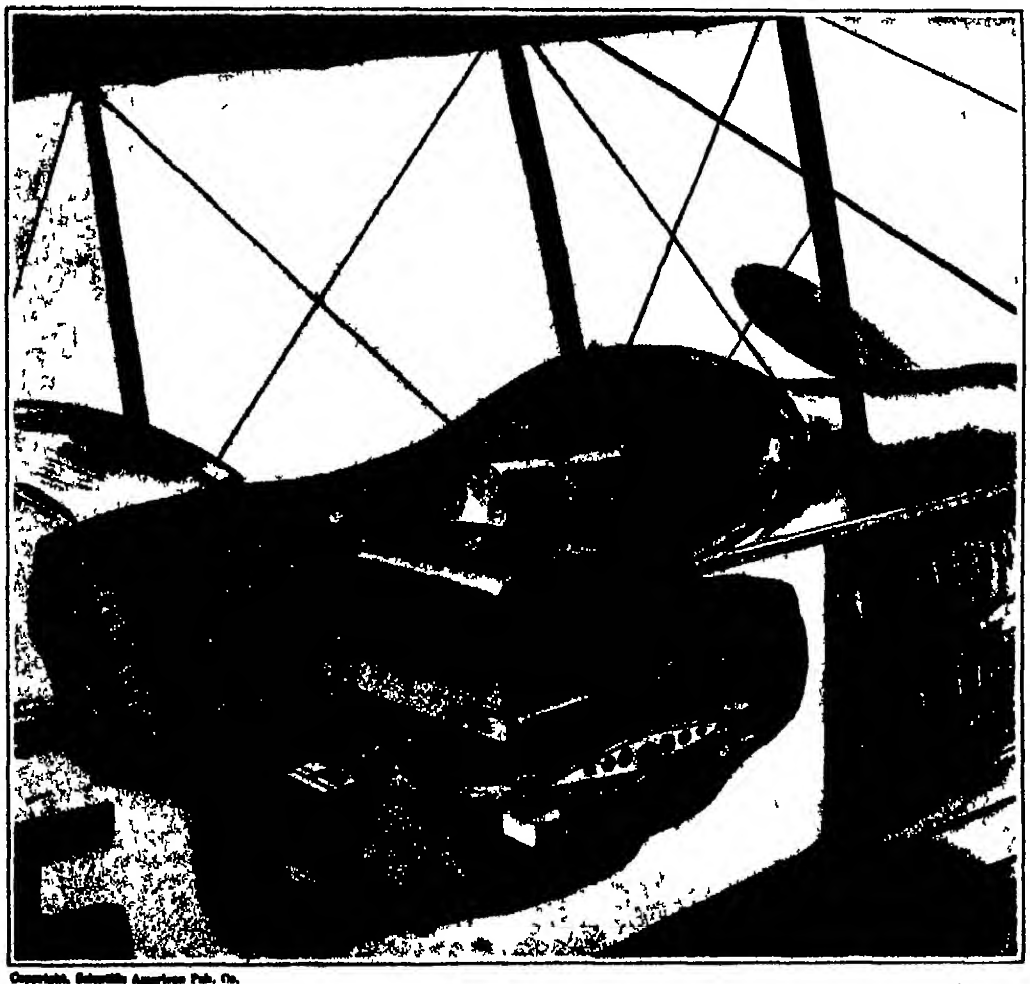
In contrast to the war camera the commercial camera of today is much larger and has many improvements in lens and shutter which add to the certainty of operation and the quality of the results People often ask why it is not possible to use a kodak or graflex in the air In principle, the aerial camera does not vary from the camera used for high grade ground work but the conditions under which it is used vary so much from ground conditions that a much stronger design and one more adjustable to conditions is imperative The wind pressure for example is sufficient *to blow in the bellows of the ground work camera* The aerial camera overcomes this by being designed with a solid metal cone in place of the bellows

After this comes the difficulty of vibration The combined action of the wind and motor is such as to cause extreme vibration of anything either attached to the plane or located in the so-called 'slip stream' or air puffs of the propeller This vibration would of course invariably blur the picture and must be overcome

Next comes the problem of obtaining a shutter with suf*ficient speed and aperture to* overcome the difficulty of underexposure and give a sharp picture The exposure must be fast for the plane is moving at a high rate of speed, and yet sufficient light must be admitted to expose fully the negative even though light filters be used It has not however been necessary to make any provision for "stopping down or focusing as the lens is nearly always used wide open and is rigidly set at an infinite focus.

There have been developed several cameras in which these difficulties have been practically overcome for the purposes of taking oblique views In one type the wind pressure is overcome by the use of the all metal body The plane vibration is checked by mounting the camera on sponge rubber between the shield and the camera When the camera is so mounted in a swivel mount it can be used only over one side of the plane This presents another difficulty for the plane *cost* is usually one dollar a minute and to economize here two cameras are used one over each side of the plane

The latest development in shutters is the between-the-lens type which is capable of making an exposure through a three-inch opening in 1/150 second The focal plane or curtain and slit variety of shutter may continue to be used largely for taking oblique photographs, but the between-the-lens shutter is coming into general use for accurate mapping work



A—The camera. *B*—Extra magazine, strapped in place. *C*—Device for automatically making exposures at regular intervals. *D*—Instrument for determining the interval between exposures. *E*—Battery *F*—Exposure signal light. *G* Photographer's seat. *H*—Spirit level. *I*—Crank for hand operation *J*—Motor for resetting camera. *K*—Cable to pilot's signal light

Tools of the aerial camera man, as installed in an airplane

The negative magazine, if plates are used, is comparatively simple, being the usual type magazine used on the ground camera and holding twelve plates. When film is used, as is always the case in mapping work of the most advanced type, the magazine becomes a most intricate mechanism

The cause of indistinct pictures can often be laid to the haze which fades out detail and outlines. Fortunately, this haze is composed of fine water particles which reflect mainly the blue light, therefore, by cutting out the blue or reflected light with yellow filters, the haze is eliminated On ordinary plates or films the yellow filter would eliminate all the useful light, as ordinary plates and film are sensitive mainly to the blue light Therefore, panchromatic or plates sensitive to all colors must be used. Plates can be obtained that are almost as sensitive in conjunction with filters as ordinary plates are without filters.

On the ground a photographer can take his time in selecting his viewpoint, in the air his object goes by so rapidly that it requires great skill to see the artistic view at the right moment and to operate the camera at that instant The plane is at best an unstable tripod, and it requires great dexterity to get sharp and comprehensive pictures.

For oblique work, plate sizes vary from 4 x 5 inches to 8 x 10 inches. The most practical plate size is 5 x 7 inches which is the largest plate that can be used without undue bulk and weight Film is used for both oblique and mapping in 18x24 cm or 7x9¼-inch size.

The value of the oblique aerial photograph is in its value as a picture, as a permanent record of a view It is a permanent and portable record of what the eye would see and record in the memory if the observer could remain in that spot a time of unlimited extent. The attraction of such a photograph is due to the comprehensive viewpoint and the time available to study the picture, to see all there is to see and from an angle not so very strange to us. As a picture it has greater attraction than the vertical, though compared to the vertical its value is more along advertising and pictorial than technical lines.

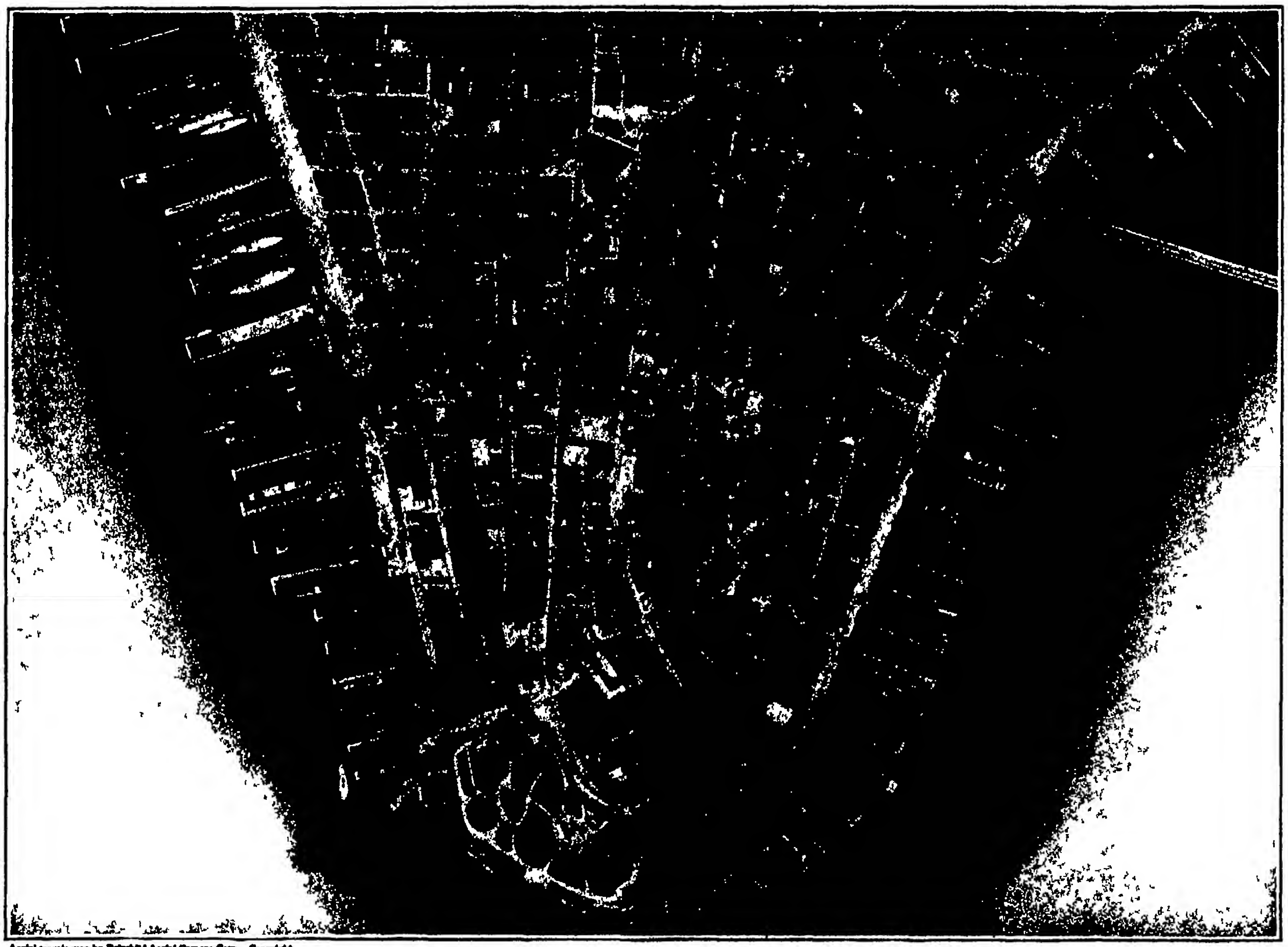
A New Aid to Better Advertising

The oblique has, of course, come into general use ahead of the vertical, for as stated above it requires less skill less technical perfection, and it may be taken at almost any altitude or angle and with little if any preliminary work The oblique view is a picture, and requires no extensive study to grasp its meaning Starting as a novelty, it was soon discovered to have commercial uses and in the years since the war it has been employed for advertising every type of industrial and commercial operation New York has been the leader in adapting the aerial photograph to commercial purposes. Its chief uses have been in showing locations such as railroad and dock terminal facilities, real estate development, port development, town planning, etc It has opened up a new method of advertising and has become an increasingly important factor in the promotion of the sale of real estate, proving its usefulness in showing the relative location of a building or site to railroad and shipping facilities, local transportation facilities and the conveniences of the immediate surroundings. It is interesting to note certain specific instances.

The Bush Terminal Company has made use of the aerial photograph to show the Bush Terminal. It has been used by the Department of Streets and Public Improvements of the City of Newark With it, for the first time, the Jersey City Chamber of Commerce was able to illustrate the truth of the slogan, "Next to the largest city in the world," by showing its position with respect to New York City A series of oblique views were admitted as evidence in a court investigation of high prices maintained by a public service corporation. Pictures before and after a dock fire aided the Erie Railroad in negotiating an insurance adjustment and enabled the railroad to share to a larger extent than perhaps would otherwise have been possible in the governmental circulating fund available in such cases.

Aerial photographs have been widely employed in booklets, house organs and newspaper advertising. They have been used to advertise production facilities, to promote the sale of country estates and city office, loft and factory buildings. An enterprising firm of real estate brokers and building managers equipped its salesmen with albums to aid in selling floor space in office and loft buildings. A bridge and tunnel construction company made use of an aerial photograph to show the approach to a new proposed bridge across the East River. The Amawalk Nurseries found it convenient to say what they had to say with pictures. To further a port development plan for Norfolk, Virginia, aerial pictures were used extensively by the Virginia Pilots' Association. And so it goes.

Arthur S. Tuttle, Chief Engineer of the Board of Estimate and Apportionment of New York City, is, without doubt, one of the most enthusiastic users of

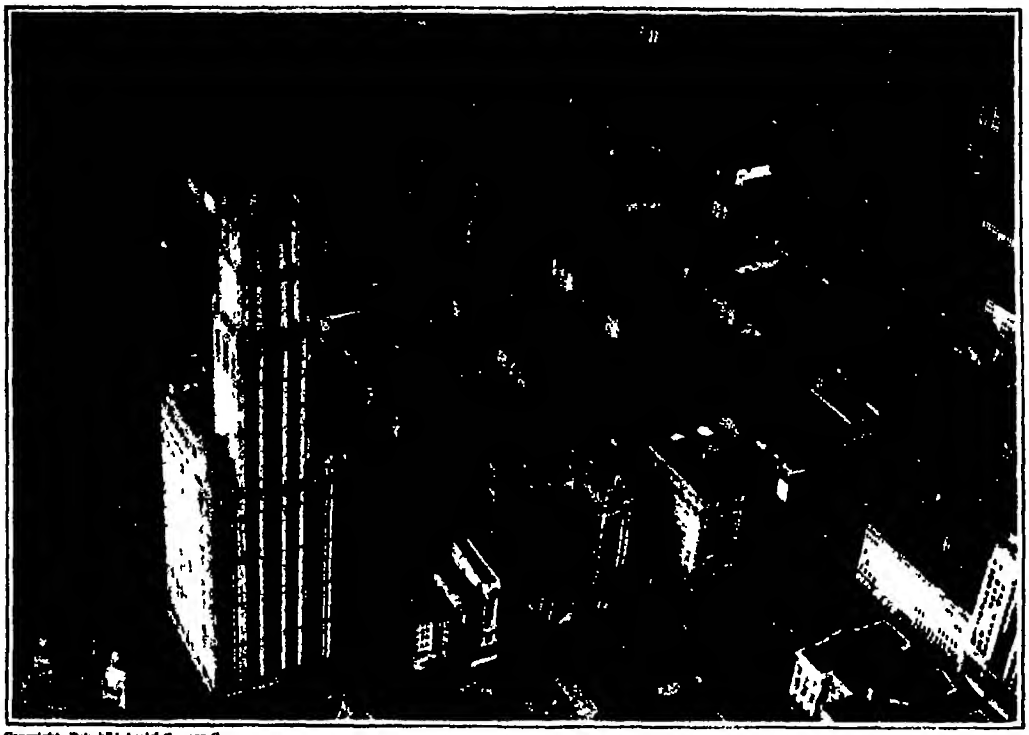


Aerial mosaic map by Fairchild Aerial Camera Corp. Copyright

This small section of the aerial map of New York City represents the "toe" of Manhattan Island. Note Battery Park in the lower center In the upper center is a dark triangle, representing the Post Office. To the left is the Woolworth Building with its marked shadow Above the Post Office, and slightly to the right, is City Hall Park The wide line in the upper right-hand corner represents a part of Brooklyn Bridge This map was made at an altitude of 10 000 feet. Obviously, reproduction in half-tone is responsible for a considerable loss of fine detail

A portion of the aerial map of New York, reproduced the actual size of the mosaic original

the aerial view. So far as we can trace, Mr Tuttle is the first city executive to order aerial surveys for a definite purpose. A great deal of controversy between the Port authority and the Board of Estimate and Apportionment of New York City has caused both parties to utilize every possible method in order to put their plan across in the most comprehensive manner Mr. Tuttle, being pressed for time, commissioned the aerial photographers to run a 50-mile survey over the territory where he proposed to develop new railroads connecting with the Narrows Tunnel. This survey was delivered to him within ten days of his order, seven days being spent waiting for suitable weather conditions to proceed with the work, therefore the 50-mile survey was actually flown and delivered within a period of four days. Such sections were surveyed as the Arthur Kill, showing the similar land condition both on Staten Island and Manhattan



Oblique view of a portion of New York City, with the Woolworth Building very much in evidence

The second phase of the subject of aerial photography deals with the vertical photograph, the taking of which is a more complicated process, involving greater technical knowledge and skill, more preparation, and an enormous amount of work in the finishing process.

Vertical photographs look strange to us, for we are not accustomed to view things on the ground from directly above A succession of vertical pictures taken in such a manner as to be of the same scale and made so that each individual picture overlaps other pictures, constitutes a mosaic map when assembled Such a map is richer in information than any map made in the ordinary way Details are evident that no surveyor could afford the time to obtain, and nothing can be overlooked or left off the map

The story of the making of the aerial photographic mosaic of Manhattan Island is paralleled by the following account of the procedure in the mapping of Staten Island, as told by Mr Louis MacSpadden, aerial photographer for the organization that photographed Manhattan Island from the air and assembled the vertical photographs making up the complete mosaic The story of the vertical photograph is best told in Mr L. MacSpadden's own words

In the Aerial Surveyor's Own Words

What is needed to make an aerial photographic mosaic? Can these requirements be met satisfactorily and can useful results be obtained "as is" today?

Let us consider each component of the ideal equipment to do such work today and then how each desire can be fulfilled To be concrete, suppose it is desired to make a mosaic of Staten Island on a scale of 1/10000 The area of the island is approximately 60 square miles. Such a mosaic would show each building, large and small Highways will stand out like a sore thumb. Automobiles can be distinguished as well as baseball diamonds—even the short cut Jones and his family use across the vacant lot is registered by the camera

First, we start our investigation, learn what we can by study and observation, and find an aerial camera which incorporates the following specifications

The camera is equipped with a lens of 12 inch focal length, speed of F 4.5 This means that our photographic work will be done at 10,000 feet elevation At this altitude the air is fairly uniform, that is not bumpy And if the plane holds its altitude within 100 feet of 10 000 feet our pictures will vary less than one per cent in scale

The camera makes a picture 18 x 24 centimeters (about 7 x 9½ inches) and uses panchromatic roll film F 4.5 lens and panchromatic film means we can use fairly heavy ray filters and that is a good feature, as it means that we can take good pictures through a fairly thick haze More than one hundred exposures can be made with the roll of film An extra loaded magazine can be taken along and the magazines changed in ten seconds. Or the used roll of film can be removed and a new one put in an operation requiring six or eight minutes This equipment, of no particular bulk or weight enables us to photograph a large area during a single flight

The camera is equipped with a between-the-lens shutter of surprisingly high efficiency Its speed can be varied from 1/50 to 1/150 of a second. This type of shutter is designed to overcome distortion which can not be overcome by the focal plane shutter This distortion is due to the time required for the slit in the curtain of the shutter to travel across the focal plane and to the movement of the camera during this travel time, caused by "bumpy" air or vibration of the plane Any angular movement of the camera becomes a pronounced movement of the focal axis when multiplied by a 10,000-foot radius of action

Another feature of this camera is that it operates automatically If the camera man finds that to obtain the desired overlap of the photographs an exposure should be made at 30-second intervals, he sets the dial on a little timing apparatus at 30 seconds. An exposure is made every 30 seconds, the shutter is tripped, the film wound ahead to the proper position for another exposure and the shutter rewound The distance between each exposure on the film can be set to the distance desired and this distance will remain the same from the beginning to the end of the roll This means that we shall get full value from the film purchased This automatic operation is accomplished by means of a 1/20-h p motor operated from a storage battery

The camera is mounted in a gimbal bearing mount with two supports that clamp upon two strips of wood fastened to the fuselage The supporting member rests upon special rubber supports so as to absorb high frequency vibrations.

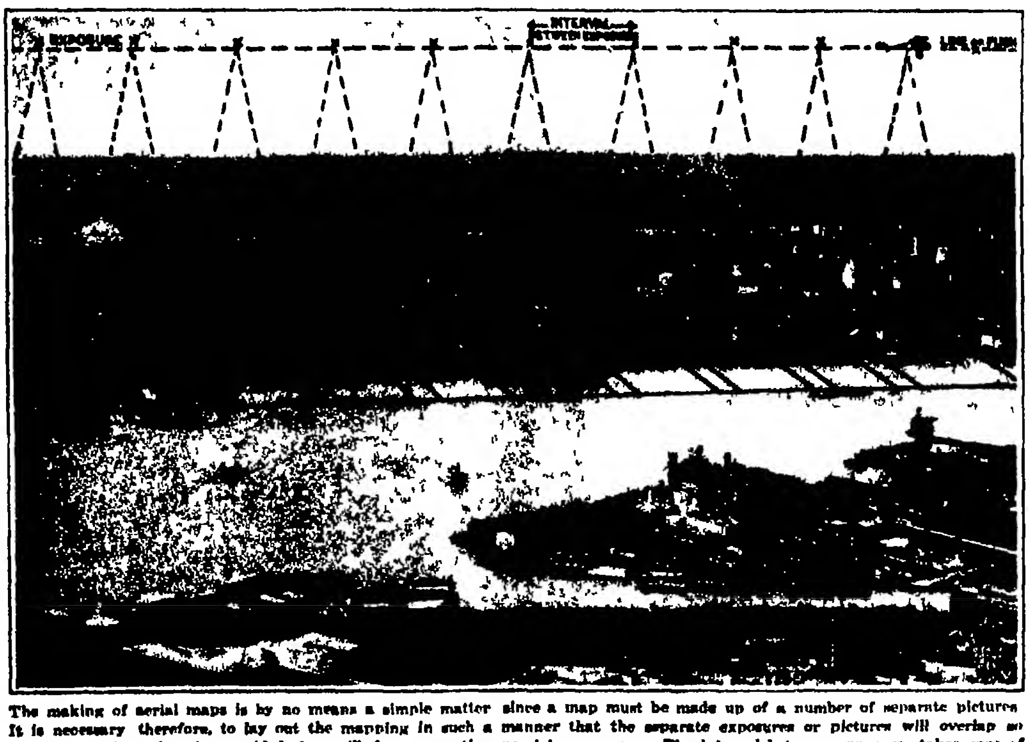
Another necessary part of the camera equipment are two small electric lights one to go where the pilot can see it, the other where the camera man can see it The wiring is so arranged and connections so made in the timing apparatus that these lights are lit six seconds before each exposure is made This warns the pilot to hold steady until the light goes out before making any necessary change in the direction of the flight It warns the camera man to make the final leveling adjustment

The total weight of the camera including the motor (mounted directly on the camera) the storage battery, the timing apparatus and the mount, is 80 pounds. The whole has a neat, compact "usable" look that gives one faith in its ability to operate as it should

This brings us to the matter of securing an airplane

We find a reliable flying company operating its own flying field The plane we decide upon as best suited to photographic use is a standard type equipped with a 150-h p motor It is not exactly the type we had pictured to ourselves but will do the work And the pilot is of the right sort Flying is no wonderful epoch-making event for him Just the day's work, and pleasant work too

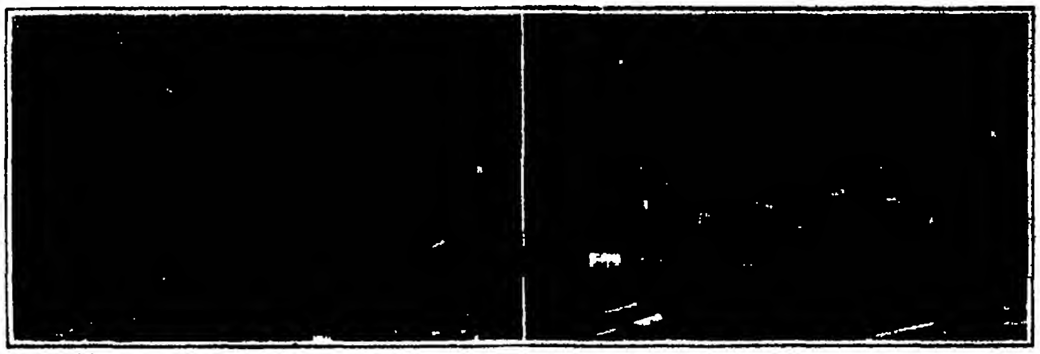
Two strips of wood are clamped to the struts of the airplane fuselage so that they fit the camera mount And a hole about 10 inches square is cut in the fabric covering the bottom of the fuselage located so that the camera in the mount will take a picture of what is below through the hole



The making of aerial maps is by no means a simple matter since a map must be made up of a number of separate pictures It is necessary therefore, to lay out the mapping in such a manner that the separate exposures or pictures will overlap so that when trimmed and assembled they will form a continuous picture or map The interval between exposures takes care of the overlap of pictures in one row, while the carefully planned flights take care of the overlapping of the rows

General scheme of exposure and overlap in the making of aerial surveys

Planning the flight necessitates getting a Staten Island quadrangle of the Geological survey. This is on a scale of 1/62500 very approximately an inch to the mile. This "representative fraction" method of specifying the scale of a map means in the case of 1/62500 that one inch on the map represents 62500 inches on the ground. One inch to the mile means a scale of 1/63360. Our photographs are planned to be at a scale of 1/10000; one inch equals 10000 inches, or 833 feet, or 6.33 inches equals one mile. At this scale each of our photographs will cover an area of 7500 x 5000 feet. (The true size of the negative is 18 x 22.8 centimeters, although called 18 x 24.)



Copyright Fairchild Aerial Camera Corp

The importance of ray filters and panchromatic plates and films is brought out in these two views, made one after the other with the same conditions. The left-hand view was made without a ray filter while the right-hand one was made through a suitable ray filter. Note relative clearness and detail in both views, more apparent in large originals than in these miniatures

A pictorial explanation of why ray filters must be employed

Planning the Aerial Survey

In planning our photographic flight we plan to do our work in what we believe to be the most efficient manner. *All planning possible on the ground is done,* while there is time to ponder. Time in the air costs a dollar a minute and you can not have conferences with your working partner, the pilot. The motor is always roaring and the wind washes any linguistic attempts into oblivion.

It is very important that the plane be flown over courses such that when the pictures made are assembled they will properly overlap both sidewise (laterally) and fore and aft (longitudinally). The lateral overlap depends entirely on the country flown over on each photographic flight or strip of photographs. And that is up to the pilot, who has many other duties to perform. He will be a busy person, with a head overflowing with things to be done and done right. It is necessary, therefore, to draw a line on the geological *map for him to follow in the flight.* This will save his resorting to memory, an impossible job, and obviate any calculating and guessing about where to fly each strip.

Looking at the map of Staten Island we see that the island is a rather irregular, fat-ended egg. We plan to fly our strips lengthwise, and since we may have a cross wind and since under good conditions it is very difficult to fly a course 12 miles long exactly as planned, we will allow plenty of overlap laterally, say 40 per cent. Then the net width of the strip will be 4500 feet, so we draw parallel lines 4500 feet apart (on the map 4500 feet is .86 inch) extending lengthwise of the island. This map is then pasted on cardboard so the pilot can handle it easily. He has only one free hand and the wind is likely to blow an unmounted map to shreds.

For the longitudinal overlap, a function of the ground speed of the plane and of the interval between exposures, we decide on 60 per cent. This may appear to be a generous overlap but means no more flying time and is playing safe.

Sixty per cent longitudinal overlap means that an exposure should be made each time 2300 feet of ground is passed over. Our plane is rather slow speed, cruises at 60 miles per hour or 88 feet per second. Twenty-three hundred sixty divided by 88 means that in still air we should make an exposure every 27 seconds, our interval should be 27 seconds.

There will be a total of 11 photographic strips, varying in net length from a short one of two miles long on the northwest edge to the longest one of 14 miles, a total photographic distance of 75 miles. This means about 170 exposures. Allowing ample time to turn around and get set on the next strip, we calculate 100 miles flown will be the measure of the working time. At 60 miles per hour this will be 100 minutes working time. We believe that 45 minutes will give us time to reach our job and climb to 10,000 feet, and 25 minutes will be ample time to return and land, our return flight being down hill. This means a total of 170 minutes in the air or two hours and fifty minutes to do the job. This is safely within the endurance of our plane.

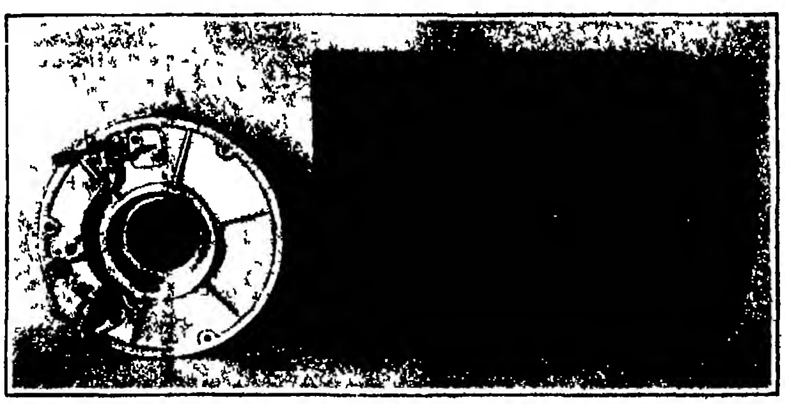
When we arrive at the flying field on the day of the flight the plane is ready on the flying line. We load our magazine, set the mount in the plane, and the camera and the batteries in the mount. We also tie an altimeter where it can be seen, meaning to satisfy our own curiosity. Also, where it can be seen and reached, we place a stop watch to determine the time interval. We also place a piece of white cardboard and a pencil handy for convenience in taking notes. Finally, we add an isosceles triangle about a foot long, *with the sides making the same angle as the fore and* aft field of the camera, and a level fastened to the base.

A—Driving motor. *B*—Mounting to allow camera to be turned to compensate for crabbing of the plane. *C*—Dark slide. *D*—Plug receptacles for making necessary electrical connections. *E*—Camera magazine containing the film mechanism. *F*—Shutter speed adjustment lever

Details of the present-day aerial camera, showing the gimbal ring mounting

On the base is an inked notch marked 60 per cent, that is 60 per cent of the length of the base from one end, which we consider the back end. This contraption is to enable us to determine the interval we should use. The spare magazine is loaded and tied in the bottom of our cockpit, the forward cockpit.

We have an understanding with the pilot that when we start on a photographic strip and reach the place where the pictures should begin, he will signal by "shaking the stick," causing the plane to fly upward and downward, slightly and frequently, or poke me with his fingers. He also signals at the end of a strip. He has the map and is on the lookout. Whenever he thinks that perhaps he is off the course, he signals to stop the camera while he circles and picks up the course again. My signaling must be done by waving a hand, to mean, "All right for that strip, now for the next," as depicted in the cover illustration, where the photographer is shown up front, and the pilot in the rear cockpit.



At the left is the latest aerial between-the-lens shutter, which operates at speeds up to *1/150th second, giving negatives without distortion. At the right is the older type of focal-*plane curtain shutter, in which the slit in the curtain travels past the negative. This shutter gives rise to distortion in the negative which is especially serious in mapping work

A study in aerial camera shutters, showing the new and the old

The mechanics start the motor and warm it up, while the pilot and I don our flying clothes. At 10,000 feet it is hardly warm, so each of us has a few sweaters, a fur-lined teddy bear, fleece-lined boots to put on over our shoes, woolen socks, a muffler, a knitted helmet that comes over the head, covers most of the face and comes down below the shoulders. There is also a soft leather face mask, with eyeholes and a small breathing hole, and a soft leather helmet and goggles.

Off for the Day's Work

We get dressed and climb into the ship. The pilot calls, "All set?" I answer, "Let's go." Then we taxi to the proper place to take off, and take off.

We make a big circle around the field and by that time have climbed to 1500 feet. It is a good day for flying, just a little haze that the K-2 filter in the lens will pierce easily. The wind is from the south, which means that the smoke from New York City is blown away from Staten Island. The light-tight safety slide is drawn from the camera and tied in the slip. The roll of film is just like rolls of film for hand cameras, *in that each end of the film is attached to eight feet* of light safe paper to make it daylight loading. We start the camera and make it operate 12 times, which puts the film in the exposure position. Nothing to do but see what we can see and measure our climb by the altimeter.

As we pass over the western edge of Brooklyn we reach the 10,000-foot altitude and locate the beginning of the first strip. Manhattan Island lies on our right and Coney Island on our left. The high buildings look high even from 10,000 feet, high compared to other things on the ground. It is interesting to see so much at one time, Sandy Hook and Harlem do not seem very far apart.

We reach the first strip extended and turn to fly the strip. First our interval must be determined. We *use the triangle, holding it base down.* We level the base, sight along the front leg, and, as the shore-line of Staten Island crosses this line of sight, we start the stop watch. Then sighting along the line connecting the apex of the triangle and the inked notch on the base marked 60 degrees, keeping the base level, we note when the part of the shore-line observed before crosses this new line of sight and note the time. It is 17 seconds. The particular point on the ground sighted moves backward, not backward and also crosswise. This means that the wind is from west to south and about 18 miles per hour. From a little table we have prepared we discover that our interval, southerly bound, is 37 seconds, and northerly bound, 21 seconds.

We signal the pilot that we are ready *to start making pictures.* We turn back and start. The dial on the timing apparatus is set at 37 seconds. The camera is held level and, as we approach the shore-line, the pilot pokes me and the camera is started.

The first strip, by calculation, should have taken just 15 exposures, and the camera has operated just 15 times when my back is poked. Everything lovely. We go over to the start of the second strip, the timer is set at 21-second interval, the camera leveled and exposures started. On this strip the calculated number is 20; the actual exposures 22.

We finish the job and head for home. The total *time in the air is* three hours and twelve minutes. The additional 22 minutes above calculated time can be laid

(Continued on page 219)

The 1922 Car

What the New York Automobile Show Tells About the Trend of Design for the Coming Year

By J. Malcolm Bird

THE New York automobile show for 1922 is now a matter of history In the show and out of it, there are something like 190 different makes of automobiles on the American market or about to be put thereon In addition to the four or five new cars that occupied feature places at the show there are some 15 or 20 more that were not on the list at this time last year Always the question that is asked at this moment is "What of the trend? Whither is automobile design headed, and how fast is it going?" Last year we replied to this question by emphasizing that the trend was emphatically in the direction of a refinement of detail The effort to find a different answer this year makes it pretty plain that last year's answer was the correct one, and that, with the essentials standardized, our automobile designers are still searching for refinements —THE EDITOR

MORE and more, as the years pile up behind the automobile industry, we find that there exists a real consensus of engineering opinion with reference to automobile design. For some years the annual shows have tended to accentuate this, the 1922 exhibition makes it more obvious than it has ever been before. Two automobiles of the present year, whatever the names or the emblems that adorn their foreheads, are apt to be as much the same machine as two buggies or two locomotives or two electric motors of different origin As in these parallel cases, there is sufficient difference in the details of workmanship and in the minor constructional features to insure that there shall be no dearth of talking points in favor of this, that, and the other model. But when stripped of everything that can fairly be included under the head of refinement in detail, the automobile of 1922 is, on the whole, just about the same thing mechanically, whatever the mark under which it is sold.

The Engine Itself

One conspicuous exception stands out to this statement, right at the start, yet it is an exception of degree and not of kind. When we count the cylinders, we find that instead of one consensus there are two—but that there is no question of an engineering disagreement here, that the two are intended to satisfy radically different demands. Where light weight and low cost are the features aimed at, the 1922 car is of four cylinders, and its water circulation is of the thermo-siphon type Where weight and extreme low cost are less the deciding factors, we have the six-cylinder car, with a water pump. It is the verdict both of theory and of practice that this is the cylinder grouping that minimizes vibration and develops the greatest degree of power and smoothness, without charging the gain to gasoline consumption Numerous sixes, in the hands of competent owner-drivers, develop twenty miles per gallon and a little more, no four can be asked to exceed this, and no eight can hope to equal it In fact, while, as we all know, the eights and twelves comprise a goodly portion of the very highest grade cars, their makers would probably be the first to concede that they are not representative, and that they are not intended to compete with the six in operating cost

The mythical "car of 1922" has the conventional poppet valves, of course, with a detachable L-head. As opportunity is given by the lapse of time to check up more fully on the performance of the much vaunted overhead valve, it becomes clear that its advantages are not those of the overhead type as against the L-head type, but rather those of individual overhead valve designs against individual L-head designs. It would not be rash to predict that the L-head will last as long as the poppet-valve does—which may not be very long, now. As for the detachable head feature, it would be a hardy designer indeed, in this year of grace, who would deny his customers access to the insides of their engines from above.

What about Poor Fuel?

Carburetion becomes more difficult every year Eventually we shall doubtless have to redesign our carburetors to meet the progressive deterioration of our motor fuels. Pending this, every designer must consider the problem of getting the engine started, and the problem of keeping it running. On the first count, the majority of designers still force us to rely upon the priming petcock Candor compels the admission that we can usually get the engine to run, with this, but it is sometimes pretty tough on the disposition, and even tougher on the battery It is therefore a pleasure to record an increase in the number of cars provided with an auxiliary of some sort to insure vaporization of the fuel while the engine and the intake are stone cold. These are, naturally, for the most part of an electrical nature, though there is also the possibility, which has not been ignored, of subjecting part of the mixture to outright burning to furnish heat for the vaporization of the rest.

The necessity for some sort of pre-heating of the mixture that is fed to the hot-and-running engine is a matter of greater agreement, no car would dare come out today without at least a means of applying the exhaust heat to the intake More complicated methods are common, too, but there is still a wide divergence as to the most profitable fashion of assisting the fuel in its vaporization The prevention of excessive cooling is part of this theme, too, and more than twenty cars have thermostatic control, either of the radiator shutters or of a cut-out in the water line

The Vital Spark

The electric system brings us back with a jolt to the standardization theme All starting motors are alike, and their means of engagement and disengagement are alike, all generator battery systems are alike all ignition systems are alike in taking advantage of the fact that the car must carry a battery, anyhow The additional weight and expense of providing a magneto as well would seem a small price to pay for the additional security, especially in view of the fact that the lightest and cheapest car of them all has the dual ignition Nevertheless, it is very plain that the "car of 1922" has battery ignition, and carries no magneto in reserve

At the front of the engine, gears are still the standard for the auxiliary drives, but their days are numbered It is admitted that chains are quieter and that their flexibility decreases the strain on the engine In the past they have been altogether too flexible Chain manufacturers have been busy on this problem and now offer chain belts of several types that will not stretch and will not leave their sprockets. No visitor to the show who looks with a seeing eye can fail to be impressed with the liberal use of chain-drive for camshafts, generators and pumps

As regards the several driving elements it would be almost superfluous to remark that the three-speed gear box has driven the four speed variety out of the United States. In the cars that have a gear-box at all it is universal The disk or plate clutch is fast becoming so, too, the cone is found on less than ten per cent of the models offered this year The dry disk maintains its lead over the oil-immersed type, and will doubtless continue to do so as long as we have such admirable friction fabrics.

Oil and Grease

Perhaps the feature that has had most attention from our car designers during the past year has been the lubrication It seems to be established that the average owner cannot or will not play the rôle of a machinist and that a car that is difficult to lubricate goes unlubricated. Accordingly the old practice of using a simple splash in the pan, and demanding that the operator oil numerous other points by hand, has been going out, and today we have in a large majority of cars a combination of the force-feed and the splash which leaves the driver little to do save watch the gage. Even the grease cups have had attention, and have been reduced in number, improved in accessibility, and made subject to high-pressure greasing of some sort. The general statement seems justified that the car of 1922 requires for its complete lubrication no mechanic in overalls, that a lady in a gingham apron is quite sufficient for the job.

The Closed Car

One of the immediate consequences of the great standardization of mechanical features that has come over the industry has been that the annual shows are to a large measure reduced to body exhibits. The buyer and the seller alike take it for granted that the car will take its owner where he wants to go at the speed that pleases him and with a minimum of attention from him, and they concentrate their critical eyes upon the shape of the body, the thickness of the upholstery, the improvement in the door latch or the window lowering mechanism, the additional inch of accessibility gained for the gear-shift lever the never-before-thought-of instrument on the dash the greater number of stowage compartments So even one who is really interested in engine and transmission in running gear and electric system, may be pardoned the confession that the outstanding impression which he took away from New York's show this year was of the strides made in twelve months by the preference for closed cars Doubtless the answer is largely in the fact that the closed cars of today really look like automobiles and not like a combination of a grand-opera house and a hearse

Even here the standardization impulse is seen For those who want something different there are the custom made bodies to fall back upon these can be had in any desired degree of eccentricity The bodies that come on the cars, however, are so much alike that when they are wearing their radiator covers, it is frequently almost impossible to distinguish between numerous makes The trend toward straight lines and horizontal lines continues.

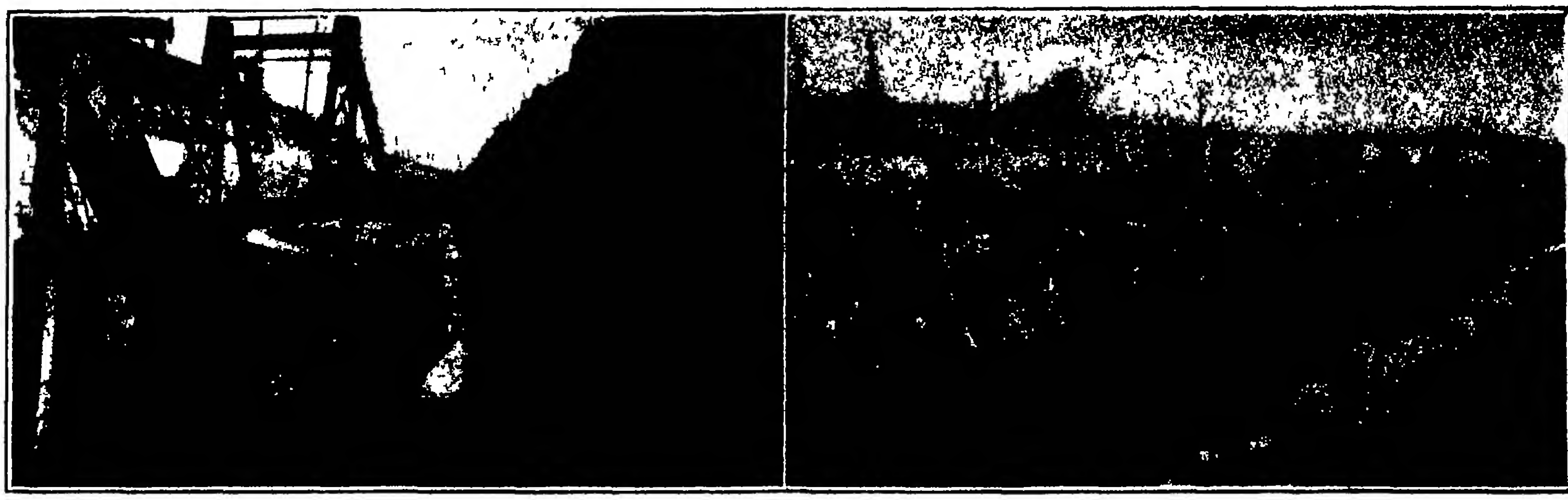
No matter what the degree of standardization in the industry at large, we shall always have with us those who deny that a thing is right simply because it is. The more the automobile becomes a cut and-dried affair therefore the more the real interest in the shows will be found in the work of those makers who have the courage and the initiative to make a departure —even if it turn out to be an ill advised one From this point of view, the most significant feature of this year's show lies in the exhibition of four air cooled cars in the place of the single make which monopolized this field for so many years up to 1921

Air versus Water

We may well pause and ask "Why not?" In theory air-cooling is just as effective as water-cooling for in either event the ultimate cooling is by air The water acts only as a go between the temperature difference which governs the issue is that which concerns the air—as every mid summer's trip demonstrates. The advantages of air-cooling in winter time are patent and conceded, so are the joys of never having to concern one's self with a clogged radiator or a pump that does not pump The rapid warming up of an air-cooled car, and the saving in weight, are further items on the credit side Of what, then, do the debit entries consist?

They consist, in the first place of an item that concerns the maker only greater difficulty of design The heat does not come out of the engine of its own accord, we must go in after it and bring it out The ease with which water does this with any sort of a fairly intelligently designed jacket, the ease with which we can then expose the water in its turn to the air in any sort of a fairly intelligently designed radiator have made it a simpler use to use water than to deal directly with the atmosphere The mere casting of an air-cooled cylinder array with its multiplicity of fins and flanges is far from a simple matter But the air-cooled car is a demonstrated success and its advantages seem well worth striving for It would be rash to predict that the car of the future will be air-cooled but it is very certain that many of the cars of the future will be air cooled, and that there will be air-cooled cars in the $1500 as well as in the $3000 class.

An interesting novelty is the effort made in one of the season's new cars to reduce vibration by means of a secondary flywheel out at the front end of the crank shaft right behind the radiator An effort to vitalize the friction drive, doing away with the gear box and all its complications as well as with the clutch as we know it, appears to be of sufficient promise to justify holding it out for more extended treatment in a later issue An ingenious item is the non stalling engine now offered with one of the cars long standard, when the engine is about to stall, the clutch is automatically thrown out



Left: Steam shovel at work in the canal cut. *Right:* Battery of fifteen marine drills south of the Victoria St. Bridge

Working to make the difference in level between Lakes Erie and Ontario available for power development

Moving Niagara Into Canada

The Great Power Canal That Carries the Lake Erie Waters to the Edge of the Bluff at Queenston

By J. F. Springer

NIAGARA marks the point where nature has found an outlet for the waters of Lake Erie, but man has found it convenient to order the matter otherwise. Niagara is not to become dry, but with the completion, in late December, of the Queenston-Chippewa Power Canal much of the water which has taken this 162-foot plunge will now go over the cliff at a point where the head available for power generation will be 305 feet. Dredges have, for nearly four years, been cutting a channel through earth and rock, in a wide swing around the falls. They have taken out 13,000,000 cubic yards of earth and 4,000,000 of rock—more than the French had done at Panama when we took over the job. The SCIENTIFIC AMERICAN *has already told its readers much about this huge power project, in the present article Mr. Springer makes a final survey of the work done and of the undertaking as a whole.* —THE EDITOR

THE largest hydroelectric plant now under construction is said to be that which will utilize on the Canadian side the great drop between Lakes Erie and Ontario. That drop may be considered as 330 feet. Of this the works will actually use 305. This is greatly in excess of the difference in level at Niagara Falls. The full power development in contemplation amounts to 500,000 horsepower. Half of this is to be developed in the works now being built. The turbines have a capacity of 50,000 horsepower each. The generators are rated as 45,000 kilo-volt ampere affairs. The turbines and generators are larger than any in use elsewhere.

The generators are of the vertical type—that is, the shaft is set in a vertical position. This means that the shafts of the turbines are also vertical and that the runners rotate in a horizontal plane. A notable feature of these generators is the air system. It is altogether inclosed and so arranged that air is received from and discharged to the general atmosphere without interfering with the air inside the station. The amount of air passing in and out of a single generator is enormous. In fact, in a single day of 24 hours, the weight of air circulated amounts to eight times the weight of the generator itself. When running at full capacity, about 6,000,000 cubic feet of air are sucked in and belched forth per hour.

The power canal will receive water from two sources. The Welland River naturally debouches into the Niagara River a short distance upstream from Niagara Falls. But the final 4½ miles of the river bed are to be utilized not to carry waters of the Welland River from west to east but to provide a channel for waters flowing from Lake Erie and the Niagara River in an east-to-west direction. The old Welland River is in fact to terminate 4½ miles from its natural point of discharge and deliver its waters to the power canal of the hydroelectric plant under construction. The final stretch of 4½ miles of channel is being excavated to provide for a generous supply of water from four of the Great Lakes.

The power canal runs north for nearly half its length and then trends off to the northeast to reach the terminal portion of the channel through which the waters from Niagara Falls reach Lake Ontario. The junction of the water from the power canal and that from the great falls is effected at the location of the mighty powerhouse. Here the water arrives under a 305 foot head.

The fore-bay—that is, the pool or lake from which water flows directly into the penstocks—has its bottom at about 514 feet above sea level. The surface of the fore-bay may be taken as at 550 feet elevation. The water flows through the wheels at about 245 feet elevation. Subtracting this level from that of the fore-bay surface one obtains 305 feet for the utilized drop.

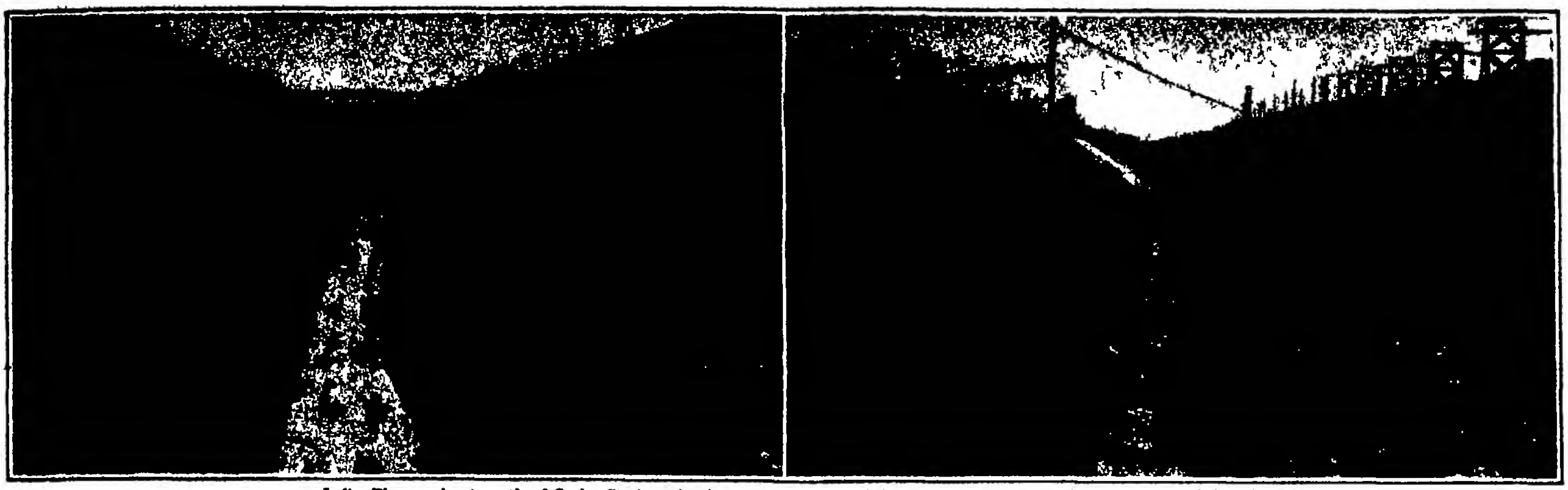
It is estimated that the volume of water that will pass through each penstock to drive the corresponding turbine water-wheel will, with the head at normal and the load at capacity, amount to about 1800 cubic feet per second. The control of this amount of water flowing down a steep penstock is a serious matter. Calculations showed that a diameter of about 15 feet would be required. As the penstocks were to be of steel plate and the sections had to be riveted together out in the open this diameter was considered dangerously large for the bottom part of the penstock. The reason centered on the fact that, with so large a diameter the plates to be riveted would have to have a thickness in excess of 1¼ inches. The riveting was thought to be of too heavy a character to be carried on in the field. In consequence of this difficulty, the penstocks have been designed to have a diameter of 16 feet in the upper part and 14 feet in the lower.

A notable feature of the plant consists in the giant control gate near the beginning of the power canal. The gate has the duty of cutting off the water supply in part or altogether. It consists of a single leaf of very large size. The width in the clear is 48 feet and the height 42½. The water back of the gate when it is down may be 40 feet or more in depth. It is said that the combination of span and head makes this gate the largest ever constructed. When the gate is lifted to maximum height, there will be 14 feet between the water level in the canal and the bottom edge of the gate. This considerable head room has been provided in order that a patrol tug may be able to pass under. This single-leaf gate will be electrically operated. Naturally, the gate is counter-weighted. This is done in pretty much the same way as in the simple and familiar case of a lower window sash. There are two main hoisting gears, which will be operated by a worm drive actuated by an electric motor.

It is thought that the design of the intake where the water from the Niagara River enters will be efficient in preventing the entrance of all ice from this source. However, it is necessary to guard against ice that may form on the surface of the power canal itself or in the Chippewa River channel. At the lower end of the fore-bay a small ice chute is being provided. This is merely an opening through the screen house where a drop gate will be installed which may be depressed to a point 12 feet below the surface of the water. The water flowing over the gate and discharging ultimately into the river below is guided by a 10-foot, reinforced, concrete pipe.

An ice skimmer has been designed, and may be utilized later on, if found necessary. This apparatus is to skim the floating ice off the water. It has a horizontal, pivoted leaf of reinforced concrete. This leaf may be elevated or depressed at will. It may thus be adjusted to the height of the water, and when so adjusted is expected to skim off the ice as it floats along

General view of the power house from the top of the cliff



Left: The canal cut north of Scaler Station showing stage of the work in June 1921 *Right:* Another aspect of the job

Points at which the canal lies fairly deep below the surface of the ground

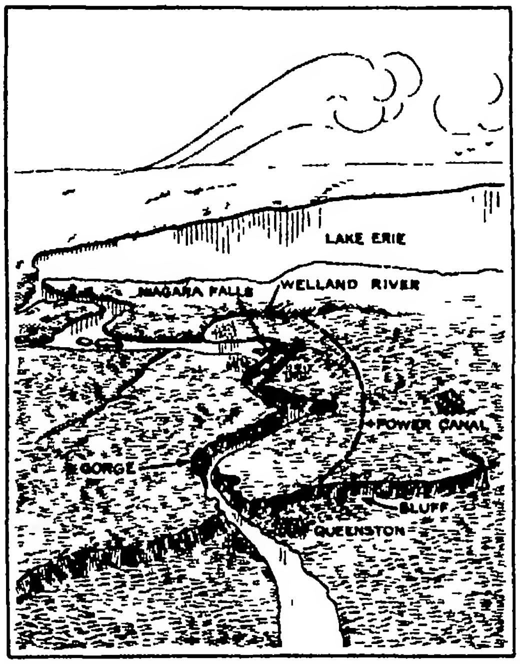
and to deliver this ice to a discharge channel the water flowing on underneath It is proposed to install this skimmer in a curve in the canal just above the fore-bay, in case the ice chute through the screen house has insufficient capacity to handle the ice

Valves control the water flowing through the several penstocks. The type of valve adopted is one which is operated by means of the pressure of the water in the penstock No external power is required. They are located at the lower end of the penstock, and this is considered an advantage

The hydraulic turbines of record-breaking size will operate at a velocity of 187½ revolutions per minute The maximum efficiency guaranteed is 90 per cent. This means that nine-tenths of the theoretical power will actually be developed It is, however, expected that this efficiency will be exceeded

That the construction work is by no means a routine job is illustrated by an interesting story connected with the "Cyclone," a big suction dredge controlled by the harbor authorities at Toronto on the northern shore of the western end of Lake Ontario In the autumn of 1920, it was desired to bring this dredge to the head of the power canal in order that it might take part in the excavation in the first mile of the canal, where there was no rock in the prism above subgrade The only possible route for the dredge was south across Lake Ontario and through the Welland Canal into Lake Erie then, down Lake Erie to the Niagara River and through the 4½ miles of the old Welland River Two great tugs were got from Cleveland and the difficult journey accomplished with their help, despite the unfavorable time of year The last four miles of the trip lay through the Welland River and here the greatest difficulties were found Bridges and shallow water created obstacles. The dredge itself deepened some of the shallow water, and another dredge cut away a channel for part of the distance. It was necessary to demolish in part a bridge at Chippewa This was a temporary affair Traffic was redirected through a railway bridge which had been out of service. When the dredge had passed the partially demolished temporary bridge, the latter was restored and the railway bridge removed Where power electric cables were in the way, they were lifted or "killed" and the dredge permitted to go ahead in safety Ice to the thickness of 4 or 6 inches had to be broken through ahead to provide a passage. Finally, the dredge arrived and began her part of the work of expediting the construction to the point of actual generation of power.

A novel method of placing concrete was adopted in recent work in the section near the famous Whirlpool of the lower Niagara River below the Falls. The side slopes of the canal trench are here very steep and also quite high The canal is being lined with concrete through its 8¼ miles of length Here, however, the great height and steepness made the placing of concrete an exceedingly difficult piece of work The vertical height is 54 feet and the slant height about 88. When this work was started, concrete strips a yard wide were placed parallel to one another and were run from below up. It was then necessary to fill in the intervals between strips. These intervals were about 15 feet wide so wooden panels 16 feet long and 3 feet wide were placed lengthwise so as to cover the space between strips These panels were held in place by means of anchor bolts embedded in the concrete of the strips. With a panel in place the space back of it could be filled with concrete and then 3 feet of the inclined height could be covered There was, however so much carpenter work involved that it became desirable to adopt some other method A big sliding form of steel was constructed. It is 16 feet long and 17 feet high It was made of ¼-inch steel plate reinforced by channel bars. The two side channel bars were extended upward and brought together a couple of yards above the form In this way a suitable draw bar was made A winch was set up at the top surface and used to draw up the sliding form as desired The concrete would be placed in the regular way for perhaps 20 feet up the slope Then the steel form would be put in position on this concrete and the winch started A slow upward movement was thus effected By adjusting the upward movement of the form and the pouring of concrete in the space behind it, it has been found possible to pour some 55 feet up the slope in the space of 10 hours. The great height of the form and the slowness of the movement make it possible, under favorable conditions of weather and the like, to leave the green concrete just below the upward moving bottom of the form in a sufficiently stiff condition to stand unprotected. It is understood that this method results in a more uniform surface and a better finish The workmen doing the finishing really get access to the concrete while it is still green. The new method was, it seems, first suggested by the foreman James Leith and was then developed by the general superintendent George Angell



Bird's-eye view of country around Niagara, showing why there is a drop of 330 feet at Queenston, while at the point to which the Falls have now cut back there is but 162, the balance of the river's fall being in the Rapids. In this view north is at the bottom

A feature of interest concerns the mode of installing the hydraulic unit The chief element is the runner—the wheel turned by the pressure water This horizontal element has at the inlet a diameter of 10 feet 5 inches This is a large, unwieldy and heavy piece of cast steel When it is necessary to renew it because of accumulated wear, a considerable undertaking is involved The generator is situated above and, where the installation has been along ordinary lines, it is necessary to dismantle this large unit in order to effect the removal of the old runner and the installation of the new one In the present power house provision has been made for the renewal by leaving a suitable space in the foundation underneath this runner chamber so that it will be possible to take out and put in a wheel without serious disturbance of the overhead electrical unit It is only necessary to remove a section of the draft tube underneath the runner in order to make the principal preparation

Altogether this new plant for the utilization of what may be called Niagara Falls waters makes an advance in the development of hydroelectric possibilities.

The Whirlpool section of the big cut

Rock Dust Poisons the Human Body

PROFESSOR COLLIS has been conducting some experiments on the effect of dust on the human body He has shown that silica or rock dust is actually a poison on the human body It is, of course well known that men who work in dust are liable to tuberculosis, for instance, the South African gold miners, who are especially exposed to fine particles of quartz, and who develop what is known there as miner's phthisis such workers are also susceptible to kidney troubles. The experiments go to show that minute fibers, which are free in the atmosphere, collect dust particles and hold them in suspension so that they are inhaled

Our Point of View

Our Common Ancestry

GENEALOGY furnishes one of the oldest and one of the simplest of paradoxes. It is self-evident that each individual has two parents, four grandparents, eight great grandparents, and so on by powers of two indefinitely. But if we carry the series back for thirty or forty generations, we find that each individual of the present day requires far more ancestors of this period than would be provided by the world's entire population of the date. The answer, of course, is that the lines of descent cross and mingle in inextricable confusion, so that every ancient forbear must be counted over and over again, no one can possibly guess how many tangled lines lead down to him from a single couple of the Norman period.

A consequence less frequently realized is that we are all cousins. Carry their lines of descent far enough back, and we must find that any two Caucasian individuals have many ancestors in common. This, too, is evident when once we have stated it, but few would make a sufficiently low estimate if asked how far back we might expect to go in pursuit of the common forbear, and few would realize how utterly unnecessary it is to make any reservations other than the obvious one that both subjects be the same species of Homo.

Writing in the *Scientific Monthly* for December, Dr. Jordan of Stanford University gives some details of the work done by Miss S. L. Kimball in tracing the descendants of one Isabel de Vermandois, who died in 1131. The good Isabel was married twice, both times to a husband of noble blood. She was herself descended from Charlemagne through six separate strains, and her second husband from King Alfred. The line of descent from each of her four children accordingly passes through a long series of English nobility, each allowing a younger son, a daughter or a daughter's son to drop from time to time into the middle class or even into the peasantry. Hosts of her descendants are, of course, lost so far as tracing their lineage is concerned, but the prominence of numerous lines emanating from her, combined with a series of propitious circumstances as regards many of her less distinguished offshoots, have made it possible for Miss Kimball to present a surprisingly comprehensive array of her proven descendants.

Dr. Jordan quotes a number of complete lines of descent from the Lady Isabel to persons of today and yesterday whose names mean something to us. His samples certainly justify him in quoting Miss Kimball's remark that the entire English-speaking population of the world consists of the "in-bred descendants of Charlemagne," through Isabel. Among those thus listed (the figures in parenthesis indicate the number of generations in the line of descent) are the typical colonial aristocrat George Washington (23), the most representative "commoner" of history, Abraham Lincoln (27), the leading present-day exponent of royalty, George V (27), three distinguished Americans of, apparently, wholly diverse origins in Grover Cleveland (26), Theodore Roosevelt (23), and Robert Edward Lee (20), the wife of our second President, John Adams (15), and hence his only less eminent descendants, a New England type analogous to that of Washington and Lee, a representative of the uncompromising Puritan in Jonathan Edwards (20), and, by way of including "people like you and me," Miss Kimball herself (28) and one Mr. F. E. Parr, apparently a New York State farmer, who boasts descent through 27 and 28 generations from both of Isabel's husbands, as well as another line that goes straight back through William the Conqueror and King Alfred to the Wessex kings.

By way of further demonstration that everybody is related to everybody else, the following descendants of Isabel are enumerated without full details: Nathaniel Bacon, Phillips Brooks, Edward Everett, Francis Parkman, William Ellery Channing, George Dewey, Charles W. Eliot, Ulysses S. Grant, Richard H. Dana, Benjamin Harrison, Patrick Henry, Oliver Wendell Holmes, Thomas Jefferson, J. Pierpont Morgan, John D. Rockefeller, Wendell Phillips, Nicholas Murray Butler, and Aaron Burr. Altogether, this is one of the most delightful scientific articles we have ever perused. It has in it all the human emotions—and not the least of them is the humor of the idea that we are all thus tied up with one another—notable with unknown, king with lowliest backwoodsman and peasant. There is nothing in it that we could not have imagined for ourselves, it is true, but this specific and wholesale citation of names—well, it is staggering!

The Submarine and Poison Gas

WE venture the statement that if the question of the abolition of the submarine and poison gas from warfare were submitted to the popular vote 95 per cent of the citizens of the United States would vote that they be outlawed. The 5 per cent of our population that would vote for their retention would include those naval and military men who are concerned with the design, construction, and operation of submarines and poison gas, and with the methods of their effective use.

In drawing attention to these 5 per cent (and it is possible that it would prove to be even less than that) we have no wish to call in question the humanitarianism of the professional soldier or sailor. They have been trained to look upon the question of war, especially in these later days, from the standpoint of the strategist, the engineer, the mechanician, and the chemist, and while it is true that no body of men is possessed of a finer spirit of chivalry, or more real human kindness, than the officers of our Army and Navy, the fact remains that for them war represents fundamentally the question of how to put the largest number of men most speedily out of action, either by death, wounding, or capture.

The moral aspects of war, and of the methods of waging it, on the other hand, are more immediately a matter of national concern, and the present popular and all but universal aversion, both to poison gas and the submarine, is due to the fact that, during the late war, the people of the United States, in common with those of Great Britain, France, Italy, and all the Allied nations, took deeply to heart such horrors as the first poison gas attack on the Flanders front, and the loss of twelve hundred non-combatants on the "Lusitania" by submarine attack.

So far as poison gas is concerned, the fact that non-combatants (women, children, and aged people) can be subjected to wholesale extermination by gas attack from the air, is sufficient in itself to set a black mark against this form of warfare for all time. So far as the submarine is concerned, there is no evading the force of the argument that the late war proved it to be very inefficient against warships, but enormously efficient when used against merchant shipping. Set a ban upon the sinking of merchant ships and the submarine's occupation is gone. Judged as a naval weapon, its sole efficiency was proved in the field of scouting, particularly in watching an enemy's ports and harbors. Except in this regard, one hundred thousand tons put into submarines does not begin to compare with an equal tonnage put into surface vessels.

Poison gas and the submarine have not been abolished as yet, but a great step has been taken in the Washington conferences in placing stringent restrictions upon the methods of their use. We are confident that the good work thus begun will be consummated in future conferences by the complete abolition of both these forms of attack.

The Automatic Stop Made Obligatory

THE Interstate Commerce Commission in issuing a sweeping order directing forty-nine railroad systems to equip certain congested sections of their main lines with automatic train control devices has acted in the same spirit which led the government many years ago to enforce the use, on all freight trains, of both the Janney coupler and the automatic brake.

As one of the earliest advocates of the use of the automatic stop, the SCIENTIFIC AMERICAN congratulates the Interstate Commerce Commission on the judgment which it has shown in issuing this order; for the automatic stop is the last logical step in a system for the prevention of collisions, which, commencing with the semaphore, has developed through the block signals (first hand-operated, and then electrically-operated) to the present device, which eliminates the human element, and thus removes an all-too-frequent cause of collisions.

The report states that the investigation by its special train council committee has demonstrated to the satisfaction of the Commission that automatic train-stop devices are practicable. "Our investigations have shown," says the report, "that automatic train control has long since passed the experimental stage. In fact, no safety devices such as the automatic coupler, the air-brake, and the automatic block signal, were perfected to as high a degree as the automatic train control before they were either ordered installed or were voluntarily adopted." We are told that, after fourteen years of investigation and study, the service tests under varying conditions, and the results obtained in the actual employment of this device over periods of years, have clearly demonstrated the practicability of and the necessity for automatic train-stop control. Hence, it is considered that the time has arrived when the railroads should be required to select and install such devices as will meet the specifications and requirements of the Commission. For the reason that the Commission does not wish to discourage efforts to automatically control trains without the aid of fixed wayside signals, the installation of the automatic stop will not be limited to roads which are already equipped with automatic block signals. It is believed that it is possible to apply train-stop or train-control devices often where automatic block signals are not in use.

As a further protection to the traveling public (to say nothing of valuable freight), the importance of this order can scarcely be overestimated, for it cuts out the possibility of accident through failure of the human element. Faulty vision, carelessness, or sudden physical collapse of the engineer can no longer produce such disastrous collisions as occur too frequently, even in this age of automatic block signaling and improved train and track equipment. It is well within the resources of the mechanical and the electrical engineer to produce automatic equipment which will absolutely prevent collisions, provided it is maintained at all times in first-class working condition. Proof of this is to be found in the New York subway system, where for many years past express trains running at forty to forty-five miles an hour, under a headway of from one and a half to two minutes, have carried over a billion of passengers without the loss of a single life through collision.

It is true that certain automatic stop systems are, or rather were, subject to disablement in storms of snow or sleet; but we understand that there are certain mechanical devices which have completely overcome their winter troubles. Furthermore, one or more systems have been developed in which electrically controlled apparatus on the locomotive is affected inductively by a signal circuit at the track side.

Can Change of Proportions Ever Constitute Invention?

IN a recent decision involving a patent for a metallic alloy, a Federal Court of Appeals has held that while the proportions of the various metals were slightly different from those theretofore employed, there was no evidence to show that the change in proportions had produced any new result. The patent was therefore declared void; but there was a strong intimation that had there been evidence of the sort suggested, the decision might have been different. As indicating

Our Point of View

what might have turned the scales, the court cited among other cases the one commonly known as the Minerals Separation Case, wherein the United States Supreme Court sustained a patent for a method which differed from a prior and long-used method only in that there was employed in the process an amount of oil specifically less than one per cent.

There was considerable evidence in this *cause celebre* to show the greater effectiveness of the process carried on with less than one per cent of oil, as against the old process where oil slightly in excess of this percentage was employed. But regardless of this, is it not questionable whether one who merely changes the proportions of known ingredients or agents can be said to have exercised the inventive faculty? Suppose a mining engineer, using an old process and seeking to produce a better operation and improved results, experiments by altering the proportions of certain substances employed in the process. Even if his efforts be highly successful, is it conceivable that he has done anything more than was expected of him in view of his education and experience in the particular work in hand?

Or let us assume that the housewife embarks upon the baking of bread. She follows a recipe which calls for the mixing of flour, water, milk, yeast, shortening: she puts these together as instructed, and gets the oven at the designated temperature, and confides her mixture thereto; and as a result of all this she produces bread. But she is not satisfied and she starts a series of experiments to see whether she can not get a better result. She does not change the ingredients in any way. She merely alters the proportions—a little less milk, a little more shortening, perhaps. In time she produces in this way what she regards as a satisfactory loaf of bread. Has she made an invention?

We do not believe that any court would so hold. The method of attack upon her problem used by our housewife, as by our mining engineer and our metallurgist, bars any claim to true invention. She may have succeeded in getting from the flour more of the nutritive value, it may be she is the first to do this, in the proportions hit upon by her the chemical reactions of rising and baking may be materially different from what they familiarly have been. Yet we can not concede that she is an inventor.

The engineer and the metallurgist who produce new and better results by a change in proportions have done nothing more in their fields than the housewife in hers. With all due respect to the courts in their decisions outlined above, we can not see that anyone who simply varies the proportions of known ingredients in carrying out an old method or in the production of an old alloy can possibly be conceived as having made an invention—no matter how startling the consequences of the alteration in formula which he has made. We well know, for instance, that in the Minerals Separation case the new proportions employed by the patent which was upheld are such as to lead to a process of "flotation" altogether different in theory from that involved in previous separation by oil. But the mere chance unfolding of an unsuspected chapter of natural law by an experiment which any one at all versed in the art might fairly have been expected to try is not, in our mind, invention. Discovery it is, yes; the anticipated discovery of the inventor, never.

We think also that we are justified in applying this reasoning to mechanical construction. Can it ever be said that changing the size and proportions of parts in a machine, even though the machine be extraordinarily improved thereby, involves invention? Would one who takes a child's perambulator and makes it large enough so that it can be used as a horse-drawn vehicle be an inventor? We can see no difference in what all these parties have done. If such patents are sustained it will result in letting down the bars which now separate the realm of patentable invention from that of ordinary mechanical skill, and in materially cheapening the efforts of real inventors.

Airplane Endurance

DID it ever occur to you that endurance, or the ability to remain continuously in the air, is by all odds the most important qualification in the average airplane? We are, of course, well aware that there are special types, such as racing machines, in which long endurance is a secondary consideration, but for the average commercial machine a wide radius of action—the ability to leave the ground and stay in the air hour after hour, independently of landing grounds, fuel supply, and repair men—is the prime consideration.

A machine like the all-metal monoplane, which recently brought the world's endurance record to this country, is to be credited with something more than a brilliant flight in the field of competitive sport. Looked at in its broadest aspect, the fact that this little machine, with two men, went up in a snowstorm, remained aloft throughout a night marked by severe cold and a gale of wind, and came to earth after between twenty-six and twenty-seven hours of continuous flying, proves that it is possible to build an airplane today which compares in reliability with the long-established means of transportation. When the art has been developed to the point where any standard make of airplane can be depended upon to show the same reliability as this monoplane, commercial air travel will increase by leaps and bounds. We are inclined to think that the uncertainty of flying, with its forced descents involving too often fatal accidents, has been the most serious hindrance to the rapid development of airship travel.

Manufacturers of airplanes should encourage flights of long duration such as this. No stronger testimony to the excellence of a machine and its motor can be afforded than a flight of twenty-four hours or more duration, attested by recognized officials.

The rapid rise of the automobile in public confidence and estimation was largely due to the long-distance races in the early years of the development of the art. A machine that could pass through the gruelling test of a 500-mile race, at speeds of from seventy to one hundred miles per hour, left upon the public mind the conviction that the automobile had passed from the experimental to the thoroughly practical stage. This assurance was strengthened by the various transcontinental and other long-distance trips which were achieved at about the same period.

The story of the development of the airplane in respect of its ability to stay in the air continuously, is contained within a period of fifteen years. The official records of duration start in 1906 when Santos Dumont remained in the air for 21 seconds, at Bagatelle, France, in a 50-h.p. Santos Dumont machine. In 1907 Henry Farman lifted the record to 52 seconds, in a 40-h.p. Voisin machine. Then in 1908 Wilbur Wright, in a 24-h.p. Wright machine made a flight of 1 hour, 31 minutes and 58 seconds, and later in the year raised the record to 2 hours, 30 minutes and 23 seconds. In 1909 Farman, in a 50-h.p. machine of his own make, remained aloft for 4 hours, 17 minutes and 53 seconds, a record which he nearly doubled in the following year with a duration flight of 8 hours, 12 minutes and 23 seconds. In 1911, with one of his 70-h.p. machines, he set the record at 13 hours, 17 minutes and 57 seconds. Little was done in the way of duration flights until 1914, when the 100-h.p. Mercedes engine proved its reliability by maintaining a Roland machine, piloted by Langer, in the air for 14 hours and 7 minutes, and in the same year Boehm, in a 100-h.p. Albatross, brought the record beyond the full-day limit with a flight of 24 hours and 12 minutes.

During the war nothing was done in the way of duration flights, but in 1920 a Farman Goliath machine, driven by two 260-h.p. Salmson motor engines, achieved a duration flight of 24 hours, 19 minutes and 7 seconds. This has now been exceeded by the record of our own Edward Stinson, who has improved upon the European record of 1920 by the handsome margin of 2 hours and 28 seconds. In a comparison of the machines, it should be noted that whereas the Farman Goliath machine was equipped with engines of 520 combined horsepower, a single 135-h.p. N.M.W. motor sufficed for the trim little Larsen monoplane.

Are Railroad Cars Too Heavy?

FOR many years past we have been watching with no little interest the steady increase in the size and weight of rolling stock. This increase has taken place in agreement with the well-proved fact that, broadly speaking, the larger the individual unit for the transportation of freight and passengers, the more cheaply can they be carried. This is true both of the steamship and of the railroad car, but it is recognized among steamship men that, because of problems of operation which are peculiar to a steamship of enormous size such as the "Leviathan," there is a limit to which increase of dimensions can profitably be carried. So true is this that it is generally agreed that not for many years to come, if ever, will another "Leviathan" be built.

Now, we are inclined to think that the time has arrived when the railroad man should ask himself whether he has not reached, or indeed exceeded, the limit of size and weight in freight and passenger cars, with coal cars of 120 tons capacity, and Pullman cars that are about 90 feet in length and approximately as many tons in weight.

We are well aware that great size of the individual unit has always been a marked characteristic of our American railroads, and that this is due both to the geography of the country, with its vast distances to be covered, and to the demand of the American people for increased comfort, particularly in transcontinental journeys. We are not now, however, contesting the reasonableness of the demand for great size and weight in our rolling stock, but we do wish to put the question up to the practical railroad man whether in meeting these conditions we have not in, let us say, our 90-foot Pullman car gone a little too far.

The Pullman car is a 90-foot bridge structure carried upon end piers or supports represented by the two trucks. Now the weight of a bridge may be said to increase roughly, as the square of its length, and it can readily be seen that, as between a train made up of 60-foot cars and one made up of 90-foot cars, there would be a very large saving of dead-weight in favor of the short-car train. In answer to the statement that the weight of a Pullman car makes for greater ease of riding, it is sufficient to say that, although this was true in the days of light rails and indifferent roadbeds, it has but little weight in these days of 100-pound steel rail, and track with eighteen inches of stone ballast.

As to the other fallacy that the great weight of the Pullman of today is conducive to safety it may fairly be answered that, considered by themselves, superfluous weight and momentum are positive elements of danger in collision. It would be possible to build your lighter 60-foot car with as much relative strength to resist the effects of collision, as is shown by the ponderous 90-foot car. As a matter of fact a given number of passengers carried in a 60-foot car train of Pullmans would be subject to less danger in the event of derailment or collisions than the same number if carried in 90-foot cars, the inertia of the train being considerably lighter and the destructive effects less. Of course, we are supposing that in both cases the cars are built of steel, and upon approved methods of construction. Additional saving would be effected by substitution of four-wheeled for six-wheeled trucks.

Then there is the question of upkeep of tracks and bridges. The lighter concentration of weight on the four-wheeled trucks would be less severe on the track; the impact at rail joints would be less, and the bridge engineer would find that he could lighten out the floor system of his bridges to no little extent. We offer the above suggestions with an invitation to their discussion.

Radio for Everybody

What the Radio Telephone Service Means and How It Can Be Applied in the Home and Business

By Austin C. Lescarboura

No one has better use for the radio-phone service than the farmer, heretofore isolated from the rest of the world

SUFFICIENT evidence that everybody is interested in radio telephony would be afforded by our mail bag alone, which of recent weeks has been heavy with inquiries on the subject. Not with any desire to discourage these, but simply in order that the fundamentals of the subject might be presented more fully and with less labor than is possible in individual letters, we have prepared the accompanying article, which endeavors to meet the simpler of the doubts and questions that exist in the mind of one being introduced to wireless or radio for the first time. It will be followed by other articles, of none the less general appeal we hope in spite of the fact that they will go considerably further into the subject Among the things which we have already planned thus to discuss are radio telephone transmission on a small scale, continuous-wave telegraphy, which is enabling radio amateurs to cover great distances with a remarkably small output of energy, the amateur transatlantic transmitting tests with continuous-wave transmitters, a survey of receiving apparatus for all varieties of reception purposes, and so on. In the meantime we invite inquiries on any phase of radio, or suggestions as to topics in the radio field which we might advantageously cover in our pages—THE EDITOR.

"LADIES and gentlemen, I take great pleasure in introducing Mr Percy Grainger, the famous pianist and composer, who will entertain us this evening with several of his favorite pianoforte selections. After that *I must ask you to stand* by at 9 55 so that the Arlington station can——"

A concert? No A vaudeville performance? Hardly A musicale in the home of a society leader? Not this time

It is merely a bit of radio-phone service taken at random Another time it might be Mme Lydia Lipkowska, court singer to the late Czar of Russia, or Miss Valentina Crespi, violinist, or Miss Sophie Tucker famous delineator of darky and character songs. Again it might be Governor Edward I Edwards of New Jersey, with his Christmas message, or John Steele, star of "Monsieur Beaucaire," or Herschel Jones, Director of Foods and Markets, New York State Still again, at a different hour of the same day, it may be the news of the day, carefully selected and clearly heralded, word by word, marine news, weather reports, children's bedtime stories, or other items of interest in the home or business

The Radio Voice and Its Audience

What is the radio-phone service? Where is it obtainable, and how? What does it cost?

Typical questions, these at a time when radio is at the height of popularity Only a short twelve months ago the hobby of radio was indulged in by boys and young men, with occasionally a full grown man, who, perhaps, were more fascinated by the technicalities of the radio art than by the actual feat of communication through space It is true, the radio amateurs then as now were carrying on radio conversations among themselves by means of the dot-dash tongue of the telegraph code, but it was evident that they spent a goodly part of their time arranging and rearranging their radio transmitters and receivers in their insatiable ambition to cover greater distance

Then came the radio-phone service, not as an occasional thing to startle the radio amateurs already engaged in sending and listening to the dot dash-dot messages, but as a regular established practice A subsequent development brought about a definite program, so that the person with a radio receiving set now can obtain a printed program which gives the features for each evening of the forthcoming week

And here is what we find In various cities throughout the country there are radio-phone broadcasting stations which send out the news of the day, special talks, sermons by clergymen, marine news, weather reports, children's stories, and most important of all as far as the average home is concerned, an elaborate musical program With the proper type of receiving set, it is now possible for anyone to receive the radio-phone service from the nearest station, and, if there are a number of stations within receiving range, it is often possible to receive several radio-phone services, one by one, with absolute selectivity, although they are operating simultaneously That is to say, *with the apparatus properly tuned*, one station may be heard, then, by slightly altering the tuning, another station will be heard, and so on. So sharply tuned are the radio-phone broadcasting stations that selectivity at the receiving end is quite practical, and whenever it is so desired one can select one's favorite radio-phone service with the same facility with which one selects a given phonograph record in preference to others.

Singer and accompanist at a broadcasting station, with the microphone shown at the right

All of which brings us down to the elements of radio communication, in order that we may have a better understanding of what is required in radio-phone broadcasting and reception

Radio communication comprises three definite operations First, we must have a suitable source of radio energy, known as the transmitter, which is capable of imparting this energy to space, or ether, as it is called by the physicist. Secondly, the radio energy, converted into vibrations of the ether, is propagated through space in ever-increasing circles over the earth's surface, losing its power as it extends farther and farther away from the source, just as the ripples set up by a stone cast into a body of still water spread out in ever-increasing circles which become less and less pronounced as they go away from the center Thirdly, an instrument capable of detecting the disturbances in space or ether is set up at any desired point in order to intercept whatever message or sounds the radio waves may convey This instrument is known as the receiving set

Now, it must seem quite evident that the more powerful the transmitter employed, the more far-reaching must be the radio waves. Conversely, the more sensitive the receiving set, the greater its ability to receive weak radio waves. In fact, with a given receiving set the radio waves from a transmitter three hundred miles away may be too weak to be detected, while the same waves can be readily detected and heard with an elaborate receiving set which includes suitable sound-amplifying apparatus.

A Question of Distance and Price

So the reception of radio-phone service resolves itself down to a matter of distance from the transmitting station, and the receiving set employed. Let us take a typical instance One of the foremost broadcasting stations is that of the Westinghouse Electric and Manufacturing Company at Newark, N J., designated as WJZ. All radio stations, by the way, have certain call letters to identify them, just as automobiles have license plates. It would not be practical for every radio station to give its full name, ownership, power, location and other facts every time it sent a message. Hence a call letter, assigned by the Government, serves to identify the station, while special call books tell at a glance what each call letter represents.

To return to WJZ, located at Newark, N J The radio-phone service broadcasted by that station may be divided into imaginary zones. First there is the 25-mile zone, which takes in all of Greater New York, a good part of Westchester County to the north, a little of Long Island beyond the city limits, and a considerable stretch of New Jersey suburbs. If you are within the 25-mile zone, you are indeed fortunate, because the simplest kind of receiving set will enable you to receive the radio-phone service. Thus a $25 receiving set will give the utmost satisfaction, in connection with a pair of head 'phones which are included with the set. If more than one person must listen in at one time—and it is no uncommon occurrence for several members of the family to lay claim to the 'phones when there is a real treat in the air—an additional set of 'phones may be added. Single 'phones, which may be held up to the ear, will also serve quite nicely where a number of persons are to listen in at one time.

WEEKLY PROGRAM
RADIO-PHONE SERVICE
WESTINGHOUSE ELECTRIC & MF'G Co.
STATION W J Z, NEWARK, N. J.

MON., DEC [illegible], TO SUN., DEC. [illegible], [illegible]

This program can be heard by any one with suitable radio receiving apparatus within a radius of 100 miles of Newark.

The service is absolutely free.

Tune Instruments for 360-meter waves.

REGULAR CONCERT
DAILY [illegible] to [illegible] P. M.

MONDAY Mme. May Peterson, Prima Donna Soprano, Opera Comique, Paris

TUESDAY Oa-Ka-Non-Ton, Indian Baritone; Messrs. Bertram Haigh and Ralph Brown, French horns; Miss Anita Wolf, Pianist

WEDNESDAY Mme. Gretchen Hood, Prima Donna Soprano, Theatre de la Monnai, Brussels

THURSDAY Miss Helen Davis, Soprano; M. Cliff Young, Pianist

FRIDAY Westminster Orchestra

SATURDAY Dance music

SUNDAY Miss Ethel Mackey, Soprano and Miss Mary Emerson, Pianist. Sacred Music

OTHER FEATURES

General News Newark Sunday Call News Service, daily, 7:55 P. M.

Children's Hour "Man-in-the-Moon" stories, by Miss Josephine Lawrence © Newark Sunday Call Tuesday and Friday, 7:00 P. M.

Hourly News Service Newark Sunday Call, weekdays, every hour from 11:00 A. M. to 7:00 P. M. on the hour

Radio Amateurs' Night Thursday 7 P. M. J. B. WALKER editor Scientific American

Weather Forecast (Official Gov't) Daily, 11:00 A. M., 5:00 and 10:05 P. M.

Marine News - Marine Engineering Service, weekdays (except Saturdays), 2:05 P. M.

Official Arlington Time - Daily, 9:55 P. M.

(Program subject to change)

Typical program of a radio-phone broadcasting station, mailed out weekly to interested parties

But let us consider the case of a person outside the 25-mile range. Consider the person in Trenton, which is some 50 miles distant from WJZ at Newark. In order to receive the WJZ radio-phone service, this person will have to employ a more elaborate set. The simple $25 one is no longer effective at this range. Of course, radio is by no means uniform, and there are freak conditions when a $25 set may receive over a much greater distance than normally But it would be poor policy to count on freak conditions, hence we must consider the problem in absolute terms. Therefore, we must employ a receiving set with more elaborate tuning equipment, making use of a vacuum tube detector in place of the crystal detector of the cheaper sets. Such a set may cost upward of $50. Indeed, to quote Mr. Louis Pacent, a well-known authority, radio telephony may be received at a cost of $1 for each mile of distance spanned.

Going outside the 50-mile zone, let us consider an individual in Philadelphia or Albany or Atlantic City Any one of these points is so far from WJZ that a

most elaborate receiving set is required, which not only tunes sharply and possesses a vacuum tube detector, but also comprises amplifying equipment to build up the attenuated radio waves to suitable audibility. Such a set must cost in the neighborhood of $150 complete, for it involves a number of vacuum tubes, storage battery, tuning panel, amplifying panel, head 'phones, high-voltage dry battery, and so on.

What Is a Crystal Detector and a Vacuum Tube?

A radio receiving set is simple, once you have overcome that awe inspired by the array of knobs and dials and name-plates with formidable terms. The receiving set must possess some suitable tuning device. All radio waves sent out by a transmitter have certain values, just as rays of light have different colors and shades. If you wore a pair of special glasses which only permitted a given shade of pink light to pass through to the eyes, you might say you were "tuned" for that shade of pink light. Blue light, yellow light, green light, purple light, and all other colors and shades save pink would not be seen by you, providing it were possible to make such accurate color filters.

Now in radio the same situation holds true, and with great precision. The radio waves are of different values, and these values are expressed in terms of meters of wave length. WJZ, for instance, transmits on 360 meters. When you manipulate the tuning knobs of a receiving set so as to have the 360-meter adjustment, you can hear the WJZ station. Tune down to 200 meters, and you hear some nearby radio amateur. Tune up to several thousand meters, and you hear the high power transatlantic stations. Hence it is the tuning of the transmitter and the tuning of the receiver which makes selectivity possible in radio communication. It is for this reason, too, that a number of transmitters can be working at one time without messing up each other's dispatches or concert, for the receiving operators can each tune their apparatus to the desired transmitter, while eliminating the undesirable waves. Most receiving sets receive radio telegraph and radio-phone waves alike.

In the receiving set—and we are only interested in reception this time—tuning is accomplished by varying the inductance and the capacity. These terms are familiar to the person with an elementary knowledge of electricity. The inductance variation is generally obtained in steps by taking taps at every so many turns of a single layer of wire wound on a large tube, said taps being connected to the points of a switch or to binding posts, or again to so-called bayonet sockets which engage with suitable plugs. The finer adjustment may be accomplished by a sliding contact operating on a single-layer coil, the wire being bared so as to give suitable electrical contact. This form is called a tuning coil. Again, the finer adjustment may be obtained by what is known as the variometer principle, in which a movable coil rotates within a fixed coil, so that the windings are either arranged for the current to flow in the same direction in both of them, or in opposite directions, or any intermediate condition. When the windings are in the same direction the inductance is greatest, when arranged in the opposite directions, or "bucking," the inductance is lowest.

Inductance is also varied in big steps or jumps, by means of compact coils. Formerly, long or tall tubes, wound in a single layer with hundreds and even thousands of turns of wire, served the same purpose. The contrast between a loading coil, as it is called, a yard high, and the present-day compact inductance coils, must be as startling to the layman as the technical characteristics have been to the radio profession.

Capacity is another factor in determining wave length. Adjustable condensers are employed for this purpose. The most common type of condenser consists of a group of fixed aluminum or brass plates, and a group of movable plates which pass in and out of the stationary plates when the handle is turned. Of course, the two groups of plates do not touch each other, the surrounding air serving as the dielectric or non-conductor.

Aside from tuning, it is necessary to convert the intercepted radio waves into audible signals. This is accomplished by what is known as the detector, and the telephone receiver. The detector may be of the crystal type or the vacuum tube type. The former is the simplest and least expensive, consisting of a suitable mechanism for bringing a metal point or wire to bear on a mineral crystal, or two crystals in contact with each other. The vacuum tube is a modified form of electric lamp in which other elements have been introduced aside from the usual filament. Vacuum tubes operate on one or more cells of dry battery, depending on their voltage rating, and preferably on a storage battery. A 22½ volt battery is also necessary, this unit being known as the "B" battery.

The detector serves to transform the intercepted radio signals or waves, which have been tuned in, into audible signals or sounds in the telephone receivers. In case of the crystal detector, one of the members, which may be a wire, a metal point, or a pointed crystal, is adjusted until a sensitive spot is found on the large crystal. The detector has to be readjusted each time it loses its sensitiveness. The vacuum tube, on the other hand, is more constant and positive in operation, and is adjusted by means of a rheostat which controls the flow of filament current. Furthermore, there is scarcely a comparison between the relative sensitiveness of the two types of detector: the vacuum tube is many times more sensitive than the usual crystal.

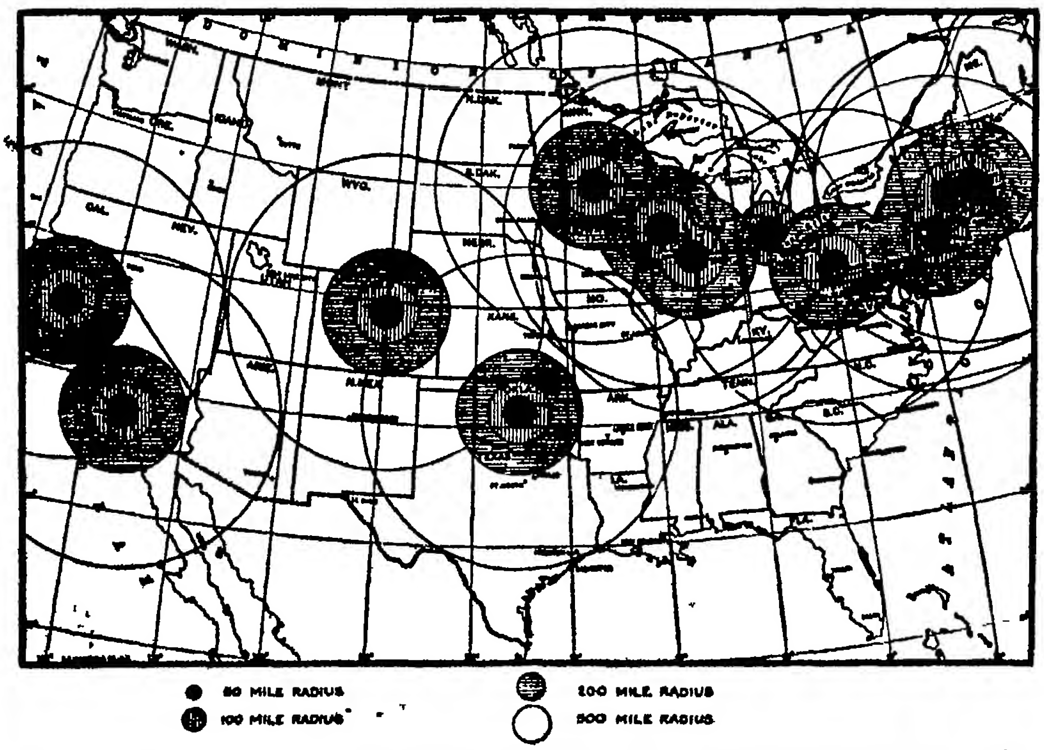
Aerial, Ground, and the Loop

Nothing has been said, so far, regarding the means of imparting the radio energy to space or ether, and the means of intercepting the radio waves at the receiving end. These functions are realized by means of elevated and insulated wires, which form the aerial or antenna as well as a ground connection. The ground connection may be made to any water supply or gas pipe.

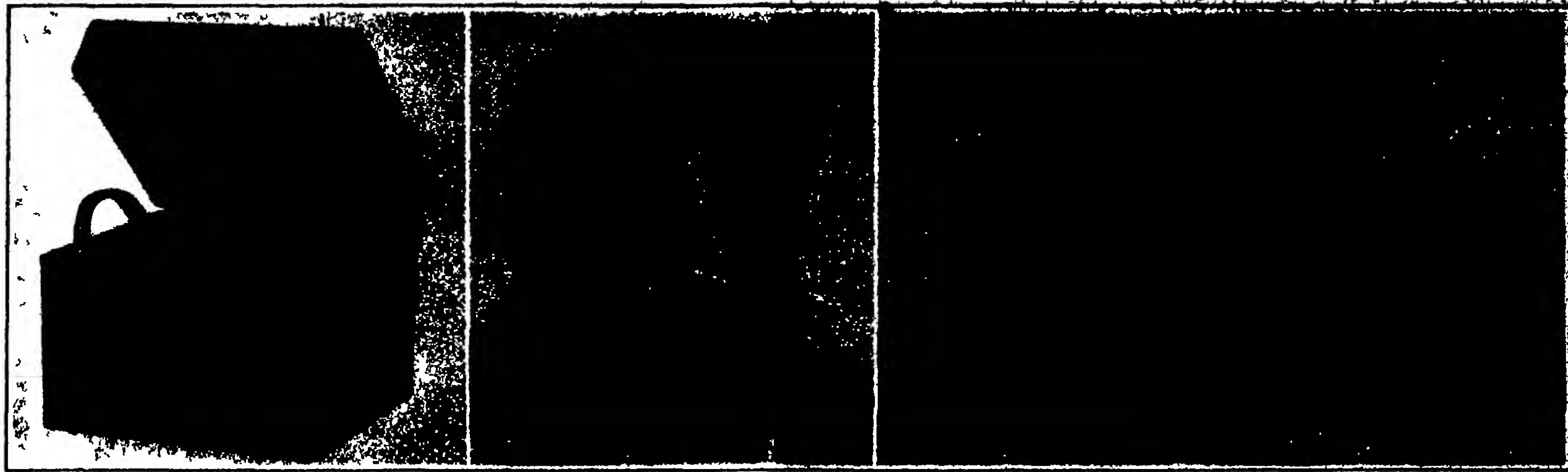
For transmitting a large aerial is required: a large station, such as the Radio Central at Rocky Point, Long Island, transmits across the Atlantic with an aerial comprising 16 wires 1½ miles long and 410 feet high. That, of course, is exceptional, and means nothing to us except by way of general information. Receiving, on the other hand, requires only a small aerial. A single wire, insulated with ordinary porcelain knobs or cleats such as are used in exposed wiring, stretched 100 feet long between a house and a clothes pole or a tree, should be ample. Two wires may give better results, and longer wires should certainly stand for better results since more energy is intercepted the greater the aerial.

The question of a receiving aerial is much the same as that of distance. Given a better grade of receiving apparatus, naturally a smaller aerial is required for a desired result. Thus it comes about that a radio amateur acquaintance, located in Boston, receives the radio-phone service from the Newark station and the East Pittsburgh station, using nothing more than a 40-foot length of magnet wire concealed about the living room

Transmitting and receiving equipment of the WJZ broadcasting station at Newark, N. J. The operator at the left is announcing the news of the day, while the operator at the right is receiving weather reports



Map of the United States, showing the approximate location of the more important broadcasting stations in actual operation or about to be opened. The circles indicate the various zones covered, at different ranges, and are intended for the guidance of the radio audience



Left: Typical $25.00 receiving set, comprising a simple tuner operated by a single handle, a crystal detector, and a telephone head set. This type of receiving set is suitable for use in the 50-mile zone with a large aerial, although it is only recommended for the 25-mile zone. *Center:* Typical $75.00 receiving set, comprising a two-adjustment tuner, filament rheostat, single vacuum tube detector, and telephone head set. The vacuum tube in this particular set operates on a single dry cell instead of a costly and messy storage battery. It draws only ¼ ampere of current, and a dry cell will last about 90 hours with intermittent use. This type is suitable for the 50-mile to 100-mile zone, or within the 50-mile zone when loudness is a prerequisite, or when a small aerial must be used. *Right:* typical receiving set of the more elaborate kind, with tuning unit, vacuum tube detector, two-stage vacuum tube amplifier, and telephone set. This set may be used with a loud-speaker, making the telephone head set unnecessary. The cost runs upwards of $125.00, and the radio-phone service may be picked up well outside the 100-mile zone

Three typical receiving sets suitable for use at various distances from radio-phone stations

molding. But it is the quality of his receiving apparatus, not to forget his two-stage amplifier, that makes this feat possible. Were this same amateur anxious to receive from stations many times farther away, he could do so by erecting a fair-sized aerial. If the aerial is small, a better receiving set is required, and amplifiers are necessary.

One of the wonders of present-day radio is the so-called loop. Instead of employing an aerial and a ground connection, a simple frame with a half dozen turns of insulated wire may be employed. This frame can be used indoors, and it simplifies the problem of radio reception in many instances. However since the loop does not begin to intercept as much energy as the usual aerial, it is necessary to fall back on amplification so as to bring up the signal or sound strength.

Amplifying apparatus makes use of vacuum tubes which differ but slightly from detector tubes. The difference is merely a matter of the degree of vacuum in the bulb and detector and amplifier tubes can be used interchangeably if necessary. In conjunction with the vacuum tubes various pieces of apparatus are used, such as closed-core transformers, sockets, small condensers, and so on. It is well to mention here, however, that the beginner in radio will do well to purchase complete units rather than parts. Radio equipment comes in units, such as a variometer unit, a condenser unit, a detector unit, a one-step or two-step amplifier, and so on, and also in complete sets. It is largely a matter of choice whether to purchase units which enable the operator to add to his set and rearrange the components to suit varying conditions, or a single set which requires no extensive wiring.

The broadcasting stations are to the radio receiving set what records are to the phonograph. One is not complete without the other. Therefore, the first consideration is to survey the broadcasting situation before going ahead with receiving plans.

Where the Music and News Come From

The radio-phone service is a new development, and as such it is still in its infancy despite the great wave of popularity which it has created for radio. It is not so long ago that the Westinghouse organization began operating the East Pittsburgh broadcasting station, following the plans of their M. C. Rypinski, to whom belongs the commercial credit for introducing the present radio-phone service. But it was not until the Westinghouse organization opened up the Newark station that the service became highly popular, the Newark station, incidentally, can broadcast to one-tenth the population of the United States, because of its location in the most densely populated area. Today radio broadcasting stations are planned for early inauguration in the leading cities of the country, so that any list of stations is almost certain to be incomplete by the time it is off the press.

The leading radio-phone broadcasting stations, operating on a regular program, are as follows:

KDKA *East Pittsburgh.* Westinghouse, 330 meters wave length. Sends out music at 9 P. M. to 10 P. M., except Sundays. News, 9.30 P. M. except Sundays. Market reports, 8 05 P. M. except Saturday and Sunday. Organ recitals, Saturday 8 15 P. M. and Sunday, 4 P. M. Sermons, Sunday 7 45 to 9 P. M. Range, 1000 miles.

WBZ *Springfield, Mass.* Westinghouse, 375 meters wave length. Concert, Monday, Wednesday, Friday, 8 to 9 P. M. Sermons, Sunday, 8 to 9 P. M. Range, 500 miles.

WJZ *Newark, N. J.* Westinghouse; 360 meters. Concert, 8:20-9 15 P. M. daily. Alternates its program with WDY. Range, 1000 miles.

1XE *Medford Hillside, Mass.* (near Boston): Amrad; 350 meters wave length. Music, Wednesday evenings. Sermons, Sunday evenings. Police reports, daily at 7 45 P. M.

KYW *Chicago, Ill.* Westinghouse; 360 meters. Music and other features daily, 8 to 11 P. M. 750 miles.

6XC *San Francisco, Cal.* (California Theater). Atlantic-Pacific, 1250 meters. Concert and news daily except Sundays for 30 minutes, starting at 4 p. m., 7 15 P. M., and 9 P. M. Range, 1000 miles.

6XG *San Francisco, Cal.*. Meyberg; 350 meters. Press, weather, grain and produce reports daily except Sundays, 4 30 to 5 30 P. M., and 7:45 to 8 P. M. Concert, Monday, Thursday, Saturday, 8 to 9 P. M. Sundays, 10 to 11 A. M.

WDY *Roselle Park, N. J.* (near Newark): Radio Corporation, 360 meters. Music, opera, lectures and radio parties, alternating its service with WJZ.

6XAK *Los Angeles, Cal.*: Meyberg; 266 meters wave length. Concert, daily except Sundays, 4 to 5 P. M. Monday, Thursday and Saturday, 8 to 9 P. M. Range, 500 miles.

The foregoing is but a partial list. There is a station at Los Altos, Cal., operated by Coleman B. Kennedy, which sends out interesting radio-phone talks on 360 meters wave length. A station is being installed in Detroit, and while it will be of low power, it will supply a radio-phone service to that progressive region. An-

(*Continued on page 220*)

Left: Typical tuning unit, which has a minimum of adjustments for efficient results. *Center:* Combination detector and amplifier unit. The tuning and amplifier units combined [illegible] can be employed well outside the 100-mile zone and in conjunction with a loud-speaker. *Right:* Typical two-stage amplifier unit, which may be used with most receiving apparatus for building up the strength of intercepted signals

Typical tuning, detector and amplifying units for receiving over considerable distances

Research Settles the Problem of Tunnel Ventilation

The Best System for Supplying Fresh Air to the Hudson River Vehicular Tunnel Tube Is Determined

By Robert G. Skerrett

THE ventilation problem of the Hudson River Vehicular Tunnel has been solved, and there is no longer room for the least doubt that the twin tubes, when finished, can be operated to capacity without menace to man or beast. The essential facts have been established after well-nigh two years of exhaustive experimental research, which has involved a total outlay of more than $80,000. In this epoch-making work the U S. Bureau of Mines and a number of eminent experts have collaborated with the technicists immediately in charge of the construction of the subaqueous highway.

Under-water vehicular tunnels have linked the two shores of the Thames River in England for some years, but these traffic arteries are considerably shorter between ventilating openings than the tubes that are to be driven beneath the Hudson so as to facilitate communication between New York City and neighboring New Jersey. Further, since the English tunnels were built, the use of self-propelled vehicles has increased to a great extent, and conveyances of this sort will predominate in the large volume of traffic which the New York-New Jersey tubes are expected to take care of. Therefore, the outstanding question has been one of insuring a sufficient supply of fresh air at all times to neutralize the gaseous exhausts of numerous internal combustion engines.

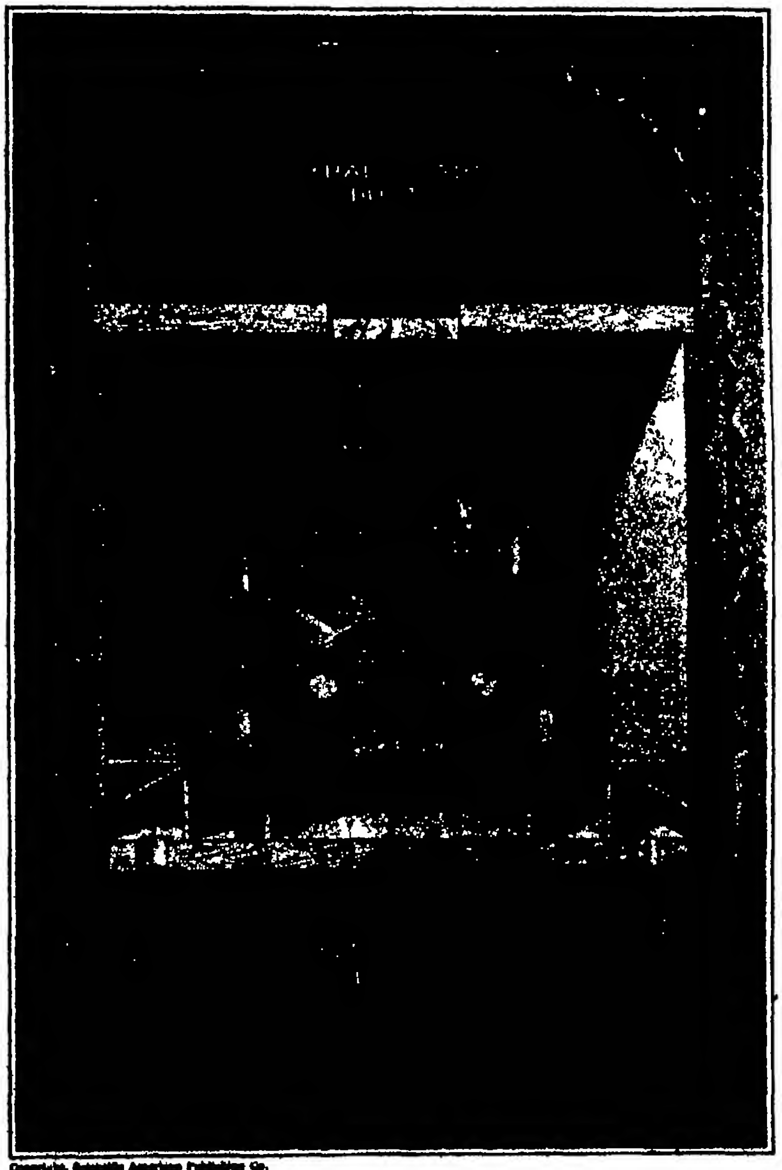
The whole subject of ventilation divides itself broadly into three divisions first, the vital one having to do with the physical well-being of persons using the tunnel and of draft animals thus threading their way from shore to shore; second, the physical means employed to effect a proper distribution of fresh air on one hand and the withdrawal of the vitiated air on the other, and, finally, how this movement of inbound and outbound air could be maintained at the lowest operating cost—especially as the blowers for this purpose are required to be powerful enough to insure a complete change of the air within each tube every minute and a half

Logically, the first division of the matter was interwoven with the probable quantity of noxious gases which would have to be diluted and removed from the tubes during rush hours or whenever, for any reason, motor-driven vehicles, with their engines running, might be brought to a standstill in the tunnel for some while. Therefore, the primary investigations had to do with the amount of gas generated by automobiles and motor trucks at various speeds and under different operative conditions of the engines, as well as the determination of the measure of the most hurtful of the exhaust gases, *i.e.*, carbon monoxide. This line of inquiry was pursued by the U. S. Bureau of Mines under the auspices of the officials of the Pittsburgh Experimental Station. The physiological aspect of the problem was taken in hand at Yale University and supervised by Doctor Yandell Henderson, acting for the time as consulting physiologist for the U S. Bureau of Mines.

In their preliminary estimates, the engineers of the Hudson River Vehicular Tunnel Commission had figured that it would be safe for human beings to be exposed to a mixture of 8 parts of carbon monoxide in 10,000 parts of air. The researches at Yale demonstrated that even infants and invalids could breathe without ill-effects and for a considerable period a combination of 4 parts of carbon monoxide in 10,000 parts of air. This indicated, at first blush, that much less fresh air would have to be forced into the tubes to maintain a satisfactory atmosphere. This encouraging revelation was, however, somewhat offset by the disclosures at Pittsburgh, for it was there established that cars and motor trucks would generate more carbon monoxide than was originally calculated. Accordingly, it was apparent that the ventilating blowers would have to be of ample capacity to dispose of the increased volume of gas—in other words, there would be no saving in mechanical equipment.

With these two matters settled, the next phases of the subject to be analyzed were those relating to the power needful to force fresh air in and to withdraw the vitiated atmosphere as well as to the method best suited to accomplish these ends. Again, the Tunnel Commission entered into a contract with the U. S. Bureau of Mines, and the latter, in its turn, made arrangements with the University of Illinois to conduct a series of tests at the latter's engineering experiment station situated in Urbana The purpose of these tests was threefold and as follows, first, to determine the coefficient of friction of the flow of air in concrete ducts such as are planned for the tunnel; second, to verify the formulæ used in computing the power required for moving air through a duct from which air is to be taken off at specified intervals, and, third, to ascertain the power losses in the bends of flues, ducts, or airways.

To this end there was built at Urbana a timber and concrete structure 300 feet long, representing in cross-section a half-sized model of the air duct that will be constructed beneath the roadway of each of the twin vehicular tubes. Surmounting this experimental duct were fearful three reading stations, in each of which were installed a variety of gages and other apparatus for registering air pressures under divers conditions of operation At the intake of the duct was set a large electrically-driven fan capable of supplying more than 100,000 cubic feet of air per minute, and later on there was erected at the other terminal an elbow typifying the connection between a tunnel tube and a ventilating shaft. Along each side of the duct there were spaced at short intervals ports or openings through which the air from the blower could escape from the duct, and these were arranged so that the amount and pressure of the exhausting air could be regulated and measured.



Copyright, Scientific American Publishing Co.

Cross-section of experimental tunnel in a coal mine at Bruceton, Pa., where operating conditions of the Hudson tunnel were faithfully reproduced, even to the temperature

The plan for ventilating the tunnels when finished calls for a dual system in each tube. That is to say, there will be a ventilating plant on each side of the Hudson, and each equipment will deal with only half of the tunnel—division bulkheads being placed in the exhaust and the fresh-air ducts midway in the length of the tubes. The model duct at Urbana was about one-third as long as the full-sized duct will be when spanning the distance between the outermost ventilating shaft and the center of the river One of the primary desiderata of the engineers was to make certain that it would be *practicable to insure a uniform distribution* of air from end to end of the subaqueous highway, and the object of the experiments at Urbana was to disclose how this could be accomplished and what would be the power required to maintain the necessary flow of air The problem was both a mechanical and an economic one for ultimately it would have to do with the annual outlay involved in driving electrically an aggregation of 63 blowers ranging from 20 to 300 horsepower each

As may be readily grasped, the ultimate arrangement of each fresh-air duct will, in principle, be *not unlike that of a pipe* closed at one end receiving air at the other and being pierced at specified intervals by numerous outlets. Such being the case how could the ports remote from the blower exhaust as much fresh air as those closer to the fan? Plainly, there must be no pockets of dead air in the actual tunnel, nor must there be any appreciable difference in pressure at any point along the line of travel The work at Urbana resolved itself into some very interesting studies in pneumatic engineering and because of the scale on which the tests were run the results were decidedly unlike those predicted by the textbooks and which are based upon experiments of a far less pretentious character

For the sake of those not familiar with the subject it should be borne in mind that static pressure represents resistance to flow, while the velocity pressure is a direct indication of the quantity of air handled. When the velocity pressure drops the static pressure rises, and vice versa. The coefficient of friction varies with velocity—*i.e.*, the higher the velocity the lower the coefficient of friction. The aim of the investigators at Urbana was to obtain a nice balance of these forces so that, with a minimum of propulsive effort, an equal volume of fresh air should be available everywhere throughout the length of the experimental duct

Theoretically, the outlets farthest from the blower should have to be larger than those nearby because of the reduced volume of air remaining for distribution, but, curiously, the tests proved this to be quite to the contrary The back pressure built up at the remotest section of the duct actually made it necessary to reduce the size of the outlets there so that they would be smaller than those of the middle section of the structure, thus showing that there would be plenty of air at the extreme end of the duct. Another revelation of importance was that regarding the coefficient of friction The demonstrations disclosed this factor to be only about half of that usually stated in manuals on the subject

Let it be said here that the outlets along each side of the duct represented the passages by which the escaping fresh air would in the vehicular tunnel reach the traffic space and the question for the investigators was to settle upon some type of intervening expansion chamber which would best serve to effect a widespread dispersion of the air into the driveway It was essential that the air have sufficient impulse to carry it to the center of the road and yet produce no sensible draft 5 feet away from the point of discharge No fewer than 25 models were built and tried out before a satisfactory pattern of expansion chamber was developed

The concluding work at Urbana was devoted to the discovery of an efficient form of combination elbow that would reduce to a minimum the resistance of air flowing either in or out of the duct at a juncture simulating a connection with a ventilating shaft Because of the turns which the air stream would have to take in entering or leaving the duct it was realized that considerable power would be needed to overcome the retarding action of the bends A number of bend models were experimented with in the laboratory before building the final combination elbow Here was a point where there would be a waste of energy unless the static pressure could be cut down The desired result was obtained by interposing in the elbow axially with the stream flow a partition or vane which had the effect of forming two ducts instead of one in the bend As a consequence the velocity of the air was increased and the static pressure diminished proportionately In short the vane in the airshaft elbow lessened by 25 per cent the force required to drive the air through the turns. To sum up the disclosures at the engineering experimental station at the University of Illinois in combination with certain features developed there indicate that the ventilating power plant as originally outlined by the tunnel engineers will be ample for the fullest service that can be imposed upon it by a maximum movement of self propelled vehicles

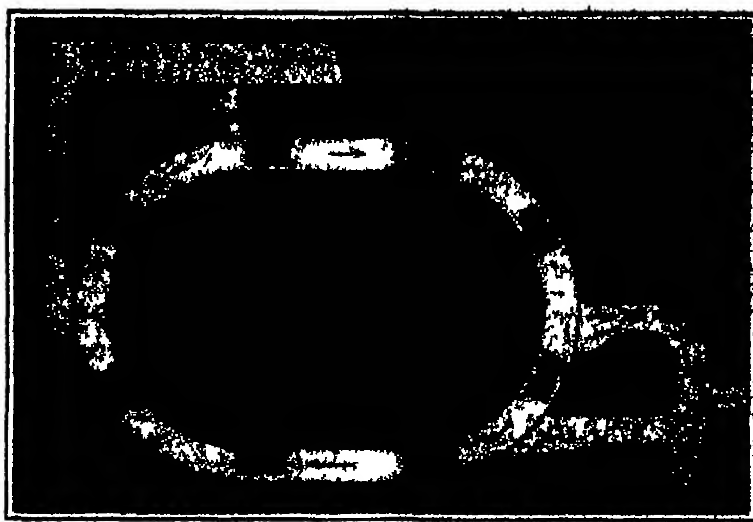
And now we come to the climatic stage of the investigations instigated by the tunnel engineers—those researches which were made at Bruceton Pa a few miles from Pittsburgh to determine whether or not it would be wisest to distribute the fresh air through the lower duct of the tunnel and to withdraw the vitiated air by way of the upper duct To this end the co-operation of the U S Bureau of Mines was again sought It had been repeatedly urged upon the Tunnel Commission by outside technical interests that the fresh air supply should be fed down into the traffic way from the overhead duct and the foul air and gases carried off by the lower duct because this arrangement would catch the harmful gases near their points of generation and dispose of them by the shortest route These men vigorously declared that any other course would be unsatisfactory if not dangerous to life

On the face of it this argument seemed sound and with characteristic open mindedness Mr Clifford M Holland Chief Engineer of the joint New York and New Jersey Tunnel Commission recommended that the question be settled in a practical manner This was done in an oval tunnel located 130 feet below ground in the very heart of the Government's experimental coal mine The subterranean speedway was constructed by linking with curved galleries two existing neighboring parallel drifts. The cross-section of the excavations through the coal seam was large enough when the tunnel was partly lined with concrete to form a rectangular space 9 feet wide and 7½ feet between the floor and ceiling This left an upper air duct 5 feet high and another beneath the road way 4 feet high The axial length of the oval tunnel is 400 feet

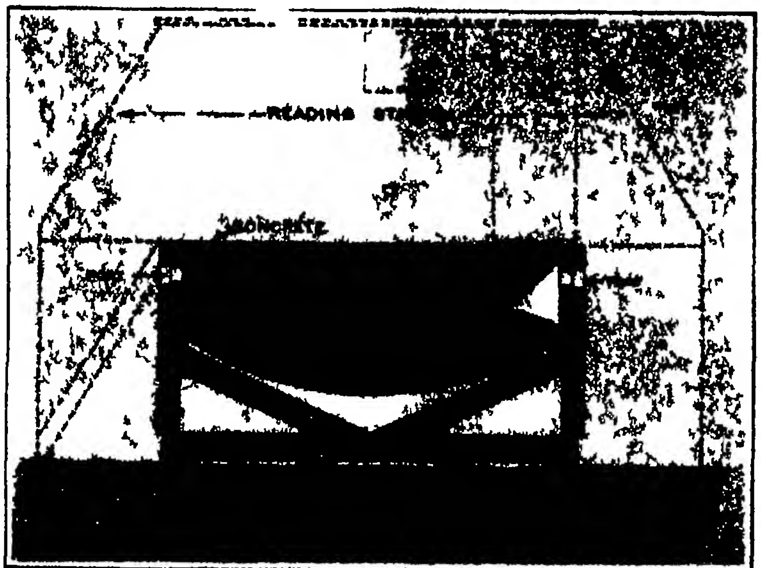
At 8 stations 5 feet apart on one of the straight sections of the speedway were set up 8 complete stationary air sampling tubes and all of these were connected by piping to a central sampling station where a pump was installed for gathering the air from the tubes The air-collecting system operated during half hour periods, and the sampling bottles or tubes were placed where they could obtain air at different levels of the speedway During each run, the [illegible] Sampling tubes were likewise set up in the exhaust duct at one station where samples were taken continuously to determine the composition of the air as it left the tunnel. This arrangement served as a check on the other readings. Each station was provided with air exhaust-gas sampling apparatus and gas-analyzing facilities. By means of these various devices data were obtained that minimized errors that might otherwise have discounted the findings had only one system of observation been employed.

At Bruceton, fresh air was admitted to the tunnel both through the lower duct and the upper duct for the purpose of establishing the relative efficiency of each method. Altogether there were seventeen demonstration tests, and during these fresh air was supplied eleven times from the lower duct, and six times from the upper one The natural tendency of the hot exhaust gases to rise quickly and the structural features of the tunnel, contributed to make the upward removal of the foul air more effective. Furthermore, the doctors in charge of the physiological tests claim that the blood absorption of gas is less pronounced when this movement is maintained, assuming that the percentage of carbon monoxide is the same whether fresh air is supplied from below or from above the speedway

The interested public may now rest content that the great engineering undertaking henceforth to be pushed to completion will involve no unsolved ventilation problems This vital aspect of the project has been authoritatively settled and passengers through those twin tubes will have nothing to fear from a lurking excess of noxious carbon monoxide The air in the tunnel will be safe to breathe during the longest interval that anyone will have to remain below the river in making the passage from shore to shore The data obtained through the experiments described will furnish basic information of prime importance in the prosecution of numerous engineering undertakings.



General features of the Bruceton experimental tunnel in plan



Cross-section of the experimental air-duct at Urbana, where the necessary data on the actual operation of the ventilating system were obtained

Partial cross-section of the Hudson River Vehicular Tunnel as it will be built showing approved arrangement of fresh-air duct and expansion chamber by which the good air will be forcibly delivered to the roadway

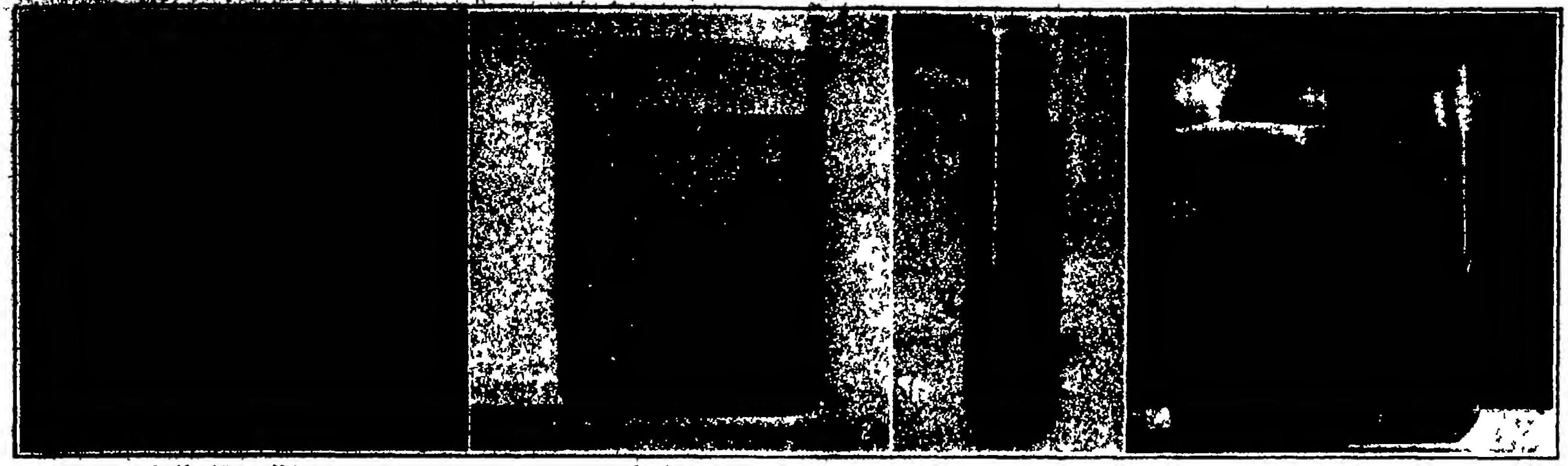
Credit to Whom Credit Is Due

IN the September issue of the former SCIENTIFIC AMERICAN MONTHLY there appeared an article entitled Asbestos and What It Means to America ' A number of interesting photographs were used in conjunction with the article. These photographs were furnished by the Asbestos and Mineral Corporation of New York City, and due credit should have been given for the use of said photographs. We now wish to give due credit, overlooked in the September issue of the former MONTHLY

Tests of Rubber Goods

JUDGING by correspondence and visits received by the Bureau of Standards, the greatest interest is shown by many persons and industries in the testing of rubber goods. Circular No. 38 of the Bureau of Standards on this subject was issued several years ago The fourth edition of this circular, for sale at 20 cents per copy by the Superintendent of Documents, Washington, D. C., will soon be issued and describes methods of physical and chemical testing of rubber goods employed at the Bureau, classification of the materials used in compounding rubber for various uses, and a short description of the method of gathering crude rubber.

As the testing of fabrics used in the manufacture of rubber goods is very important in some industries, this work is likewise treated in some detail, and an appendix contains a list of Government specifications as well as a bibliography of the papers published by the Bureau and some important books and periodicals that deal with rubber.



1. Aluminium sulfate   2. Ferric chloride   3. The sugar-copper "plant"   4 Nickel nitrate

Artificial "chemical cells" which exhibit the osmotic phenomena of living and growing plant organisms

Artificial Plants in the Making

The Study of Osmosis Under Natural and Artificial Conditions

By Dr E Bade

THE question whether the herring is salty because it inhabits the ocean cannot be answered with a direct yes or no. The salt content of the blood in various fish varies with the species and the locality inhabited by it, the concentration being generally the same as the osmotic pressure, but it is not invariably so In the blood of the shark it is equivalent to the osmotic pressure, in other fish it is much lower But other complications arise. The various parts of the body of an individual do not have the same constant pressure nor the same concentration of salt. The glassy fluid of the eye is here much richer in salt and has a higher osmotic pressure than the blood. The fluid in the body cavity is saltier than that of the blood, but the flesh has a much lower content of salt than both

But animals are not entirely placed under this influence. The eggs, and the young of some fish, which in their early stages are soft of body, delicate, and fragile, and carried about the ocean like plankton, possess a much lower concentration of salt, their osmotic pressure being minimal The same is true of other animals, notably salmon and eels, etc., which are able to live both in fresh and salt waters. But here the animals must pass a certain time in brackish water so that part of the salt in their blood can be withdrawn into the water before they pass on. If the salt content is not gradually decreased, the animal dies, the cells being incapable of resisting the sudden change of osmotic pressure.

A somewhat similar relation is found to exist in the vegetable kingdom. Plants, through their root hairs, absorb not only moisture but certain salts which are necessary for their existence. These are taken up by the process of osmosis. When the water in which the salts are dissolved passes through the membrane of the cell, it naturally creates an internal pressure, and since the membrane, which is semipermeable, allows water to enter, but does not allow it to pass out, the internal pressure must come to equilibrium. This is arrived at when the pressure of the cell content and the absorbing power of the plasma membrane are equal These turgid cells do not, of themselves, produce a rise or flow of sap. The water is pressed from cell to cell by infiltration since the infiltrating resistance of the plasma membrane varies with the pressure exerted upon it. But in this second cell osmosis also plays its part. In this way the sap is carried from cell to cell toward the conducting tissues.

If now a plant is cut a short distance above the soil, sap will soon be noticed exuding in the form of drops. At times the quantity of water thus given off is exceedingly large. Certain species of [illegible], vine-like plants, are considered [illegible] walls. The relatively cool [illegible] liquid exuded soon [illegible] sap is also supplied by [illegible] others. When Agave [illegible] is cut horizontally [illegible] of sap will flow in 24 hours, and more than 2500 grams in one week This is the plant used by the Mexicans for their "national" drink, pulque

The pressure under which the sap is exuded under these conditions is called root pressure and it is measured by attaching a bent glass tube exactly upon the stump of the cut surface and filling the tube with mercury The pressure thus exerted is greatest near the soil and gradually decreases with the height But this pressure is never the same for each hour, and varies considerably during the year Under favorable conditions, *Ribes rubrum* (currant) develops a pressure of 358 millimeters of mercury, *Acer platanoides* (Norway maple), gives 347 mm , *Acer saccharum* (sugar maple), 1033 mm *Psedera quinquefolia* (Virginia creeper), 615 mm., and *Vitis vinifera* (European grape) 800 mm The European grape exudes one liter of sap in 24 hours, while the sugar maple exudes as much as 5 to 8 liters in the same time.

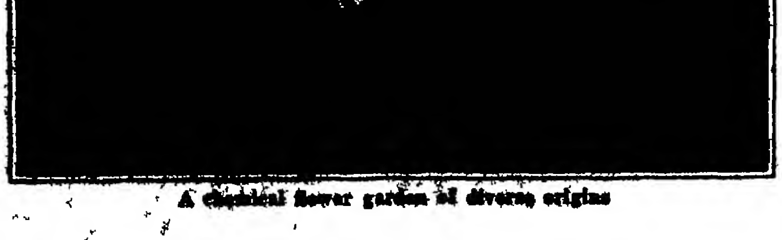
Each cell, with its concentric layers of membranes and fluids, is an osmotic system The higher plants, consisting of innumerable cells adjoining and touching make up osmotic system upon osmotic system, at least in the roots, until the sap has reached the central cylinder where other forces and factors aid in the distribution. The lower plants—the salt water algæ, the mycelium of some fungi, etc —consist of but one cell

A somewhat similar simple cell or osmotic system can easily be reproduced artificially Such a man made plant, while not possessing the vital spark of life, is susceptible to chemical and physical stimuli, and its development is hindered by poisons. Just like the living plant, these artificial plants are able to heal wounds caused in the course of growth, and since the nutritive liquid must rise a considerable distance, these products must be provided with canals for the rise of the "sap, if we may borrow the term for this use

The power of osmotic pressure, in such a simple chemical cell, is most conveniently observed by introducing a tiny crystal of cobalt nitrate, manganese sulfate, ferric chloride, nickel nitrate, or aluminum sulfate into a solution of two parts of water glass (sodium silicate) and one part of water Here the solution is separated from the crystal by a so-called semi permeable membrane After a few seconds it is noticed that the system is not in equilibrium Water passes through the membrane into the crystal The latter dissolves and produces a pressure between the liquid within the cell and the outside liquid, and this causes an expansion Here the change is in the direction of equilibrium, and the osmotic pressure is satisfied when water will pass neither into nor out of the cell

Various kind of plantlike structures can easily be produced with these and similar chemicals. If one part of water glass and six parts of water are used as the liquid, we may use seeds made by mixing 15 parts of copper sulfate, 5 parts of ferrous sulfate, 5 parts of calcium sulfate and 5 parts of water These must be dried after making the seeds about the size of a pea These will produce green moss-like structure Brown algæ-like shapes are got from seeds made by mixing 15 parts of ferrous sulfate, 5 parts of copper sulfate, 5 parts of calcium sulfate, and 5 parts of water For tree-like and bushy vegetation having green stems and white branches a mixture of 10 parts of manganese sulfate, 10 parts of copper sulfate, 1 part of ferrous sulfate, 5 parts of calcium sulfate, and 2.5 parts of water are taken

Another way in which beautiful plant-like structures can be obtained is by making seeds consisting of one part of copper sulfate and one part of sugar and placing them in an aqueous solution consisting of 100 parts of water, 10 to 20 parts of a 10 per cent solution of gelatine, 5 to 10 parts of a saturated sodium chloride solution, and 10 to 12 parts of a saturated solution of potassium ferro-cyanide. The development of the artificial plant occurs according to the temperature, sometimes requiring a few days and sometimes only a few hours Here the artificial seed first surrounds itself with the permeable membrane of copper ferrocyanide which permits the entrance of water, but does not allow the sugar to escape Because of this partial permeability, pressure is exerted within the seed which produces growth through out the entire system If the fluid is placed on a glass plate, growth occurs in one direction only, if it is brought into a deep vessel, the structure grows both horizontally and vertically Then true stems are formed, which, when they reach the surface of the liquid, spread out like flat leaves. These artificial structures develop protuberances shaped like spheres or seed pods, mushroom like structures, and so outwardly, resemble the organic forms.



A chemical flower garden of diverse origins

The Lincoln Highway of the Telephone

The Romance and the Technical Difficulties Met in Laying a Giant Cable Across the Mountains of Pennsylvania

By Harry A. Mount

AN epoch in the art of communication will be marked by the completion of a 200-mile stretch of telephone cable over the mountainous country between Pittsburgh and Harrisburg. This stretch, coupled with the cable already in use between Boston, New York, Philadelphia and Harrisburg will be the longest overland cable in the world—and more. It will bring to a successful conclusion an engineering venture of the first magnitude, which ten years ago would have been impossible

For this cable differs from the better-known ocean cables in important respects. The latter contain but a single metallic link between the continents, whereas the land cable contains within a sheath of lead scarcely larger than a man's wrist nearly 800 telephone circuits and over 175 telegraph circuits. The patient research, the ingenuity and the engineering skill which have made this possible seldom have been matched The physical difficulties of laying a great cable over pathless mountain tops are scarcely less to be wondered at

It is hard for the average man whose knowledge of the intricacies of the telephone begins and ends with the instrument on his desk, to realize that the investment in this cable, mile for mile, is of the same order of magnitude as that in a railroad But consider these facts the cable used in this 200-mile stretch weighs about 4000 tons and is spliced together from 2000 sections. The work of splicing took about 20 tons of solder, 15 tons of paraffin and 7000 square yards of muslin The poles that hold up the cable number 10,000 and the wires within it, if joined end to end, would stretch 163,000 miles. In addition, at intervals of 50 miles, there are repeater stations which house the costly and complicated apparatus necessary to the operation of the cable Every 6000 feet there is a big iron pot containing "loading coils," one for every circuit

This new cable is a unique achievement, not because it carries a large number of wires or because the cable itself is any different from those already in use, but because it marks the first successful application of what is known technically as a *fine-wire cable to long-distance communication* The largest conductors within the cable are five-hundredths of an inch in diameter and these are far outnumbered by the remaining conductors which are but slightly greater than three-hundredths of an inch in diameter Considering circuits of equal length, the installation of this cable effects saving in copper of four and one-half times over the hitherto best type of long distance cable

At one point under Broadway, in New York City, for telephone communication alone, there are 35 cables, containing a total of 47,000 wires. This vast number of wires, if placed on a single overhead line, would require poles two miles high, or if the poles were only as high as the Woolworth tower, twelve lines would be required to carry them, and the street would be literally roofed over with a canopy of copper As regards telephone communication, this is perhaps the most congested spot in the world Of the 26,000,000 miles of wire owned by the largest telephone company, about 15,000,000 miles are now in cables, valued at $300,000,000.

A somewhat similar congested condition is arising in certain of the long-distance lanes of communication, and the recently developed type of cable meets the needs of the situation At the present time three full pole lines are required to handle long-distance telephone traffic in and out of Pittsburgh to the east. The rights of way followed by these lines provide no further facilities for more open wire circuits, and the topography of the country is such that no more routes suitable for economical construction are available. It is estimated that the 175 circuits now used along this route must be doubled within the next ten years. It is just such a situation as the cable was developed to meet

Hauling rolls of cable up the mountain-side with tractors. Each roll weighs about two tons

The first telephone cables were laid under the streets of Boston, and although carrying only about twenty circuits, were extremely inefficient. Not only was the quality of the conversation very poor, but because of electro-static relations within the cable, conversation had a tendency to leak into neighboring circuits, and it made very little difference whether the receiver was attached to the same pair of wires as the transmitter, or to any other pair In fact, it appeared for a time that the cable would be quite impracticable if more than a quarter of a mile long. In 1889 a few short cables two inches in diameter and carrying a hundred wires were used with encouraging success. Since then their use has steadily increased and improvement has taken place until some of the cables under our city streets, while only two and five-eighths inches in diameter, carry 3000 wires.

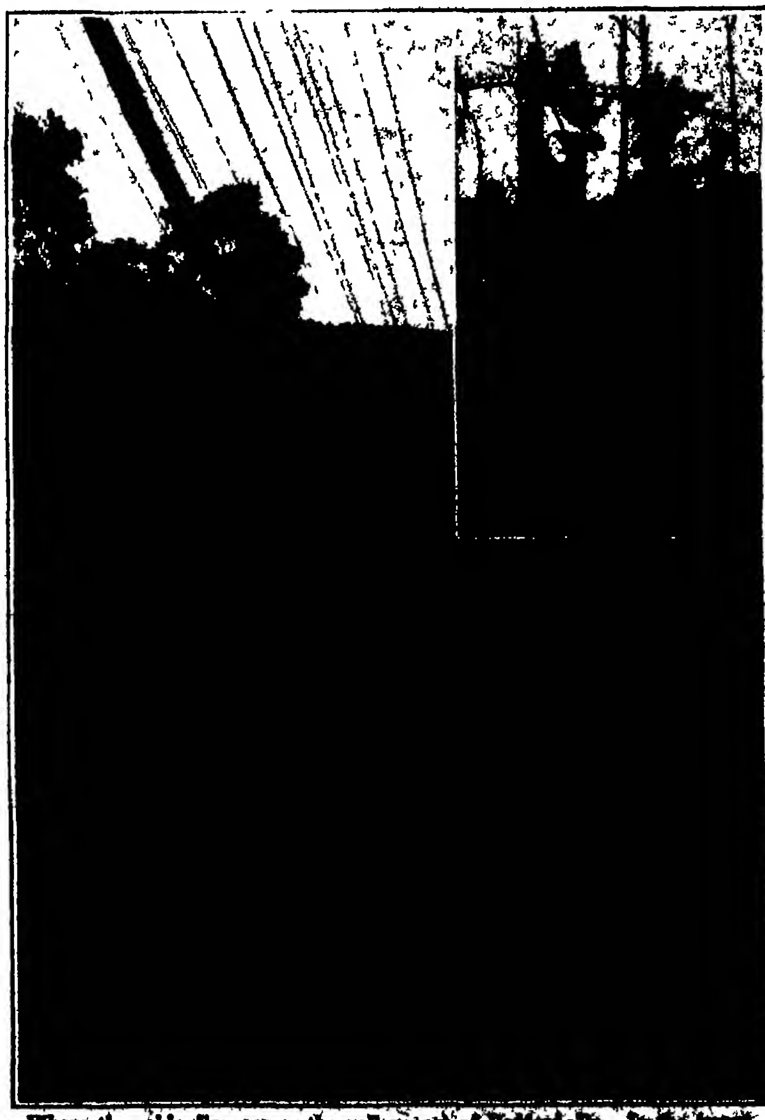
Aside from the fact that open-wire lines occupy too much space for congested city streets, they have other inherent shortcomings, chief of which is the liability to interruption of service from sleet and wind storms, and other adverse weather conditions. With the idea of making the important circuits between Washington, New York and Boston as secure as possible from storms, an underground telephone cable was built to connect these cities several years ago It has given satisfactory and uninterrupted service since its opening in 1913. But the cable itself and the copper wires within it were of very heavy construction and consequently very expensive.

The approaching need just pointed out for the extensive use of long-distance cables was realized several years ago by the engineers who have developed the nation's long-distance telephone service. Accordingly, development work was instituted with the object of determining whether fine wire toll cables could be placed on an equal footing commercially and economically with open wire toll lines. The outcome has been many important contributions to the art of communication, among the more important of which may be mentioned four-wire repeater circuits, a totally new type of telegraph system employing full metallic circuits, special loading coils and phantom repeating coils, and a new type of signalling system for circuits which carry telephone and telegraph messages simultaneously These are but a few of the developments which are contributing directly to the successful operation of fine-wire toll cables.

It is one thing to establish satisfactory communication over a fine-wire cable within the limits of a city, and quite another to talk over hundreds of miles of such cable The electrostatic capacity between two parallel wires even when held several inches apart on an open wire circuit is considerable when stretched for hundreds of miles, and when these wires are placed close together within a cable they become a condenser of large capacity A telephone current starting out over these wires charges and discharges this "condenser" rapidly and at each successive charge the original current becomes weaker Within a very few miles the current has dwindled away until it is no longer perceptible.

This condenser effect is partially overcome by placing loading coils in each circuit, size of and distance between which are carefully determined in accordance with the electrical constants of the cable, This is simply a highly efficient form of inductance and serves to neutralize the effects of capacity between the wires. A loading coil consists of a core of compressed iron dust, the grains of which are held together by a small amount of binder. In the simplest type of coil, the core carries two windings, one winding being placed in each wire of the circuit. The loading coils must be protected from all moisture, and to this end they are packed in large cast iron pots which are sealed shut.

In spite of the fact that loading coils are used, the current "peters out" or is rapidly attenuated as it traverses the cable, and before reaching the end of any but the shortest circuits would become



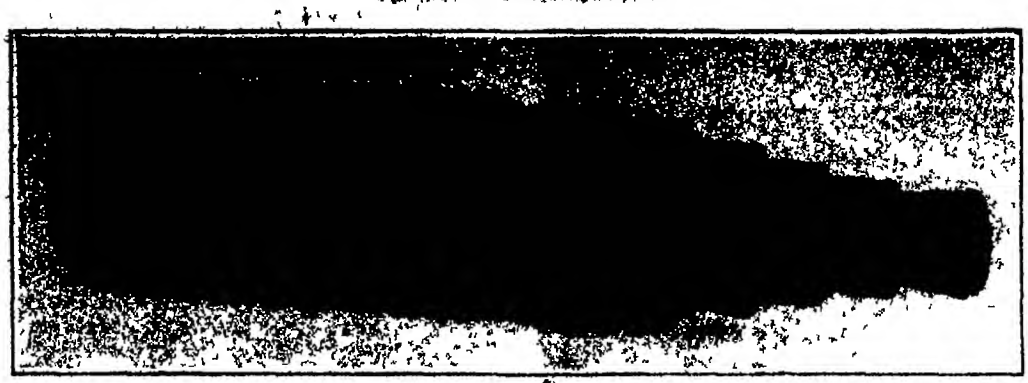
Where the cable dips across the valley east of Bedford, Pa. In the insert is shown a loading coil on the hilltop

too weak to operate a telephone receiver satisfactorily. To restore the attenuated current, repeaters are inserted in the cable every 50 miles. These repeaters are in reality vacuum tube amplifiers, somewhat similar in principle, but different in design and construction, to those used in radio work. But they are especially designed to meet the rigid demands of steady and efficient telephone service. One of the requirements of the telephone repeater is that it amplifies all of the many hundreds of frequencies in the human voice equally, that is, *without the least distortion.* It is comparatively easy to amplify a voice current once and to get a good result, but when the current must be amplified again and again, as in long-distance telephony over a cable, if the slightest distortion were present in each repeater it would grow with each successive amplification until the final result is entirely unintelligible. Suffice it to say the desired result is now accomplished, not occasionally but every time, so that a voice transmitted over a thousand miles of cable is quite as distinct as though the speaker were in the next building.

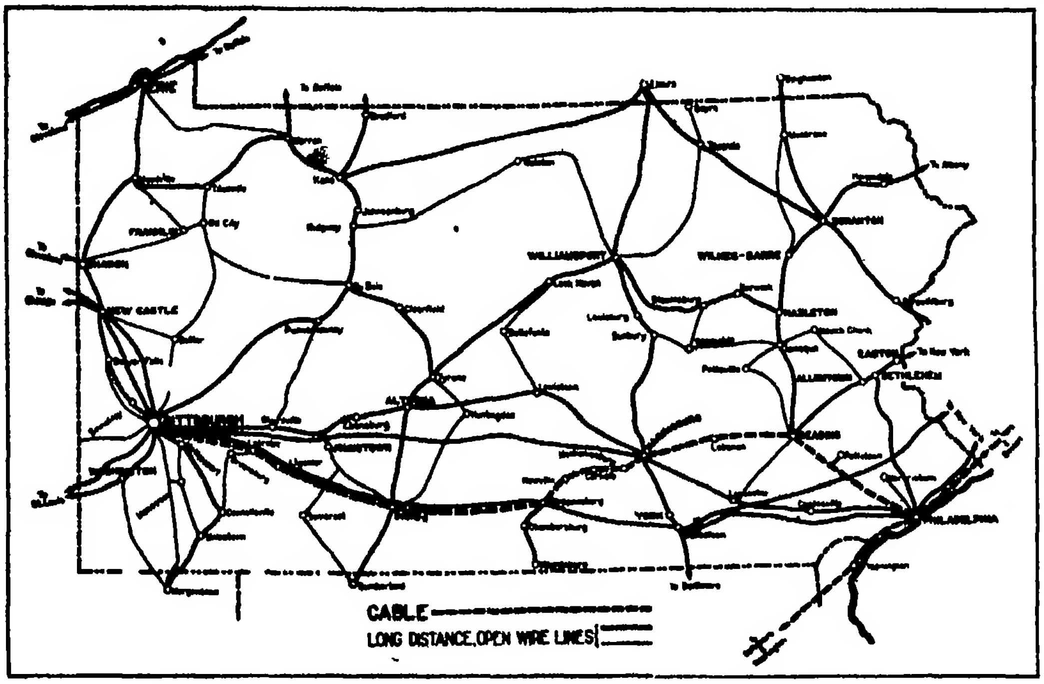
This was not the only engineering problem to over come. There was the problem of "cross talk," that is, the induction of a current in all adjoining pairs of wires and the consequent spreading of the conversation which so baffled the early experimenters. That difficulty was overcome in a simple but ingenious and highly effective way. Each pair of wires is twisted together with a different pitch thus one pair may make one twist in 12 inches, the next in 15 inches, and so on, so that the wires of adjacent circuits are "balanced" with respect to one another. This twisting is done by the giant machine which makes the cable. Hundreds of wires are fed together by this machine to form the complicated core of the cable which is then carefully baked. From the oven it passes directly to a heavy hydraulic press which molds a sheath about the core from a mass of solid lead. The lead sheath is really an alloy, for it contains about one per cent of antimony to give it certain desirable qualities. About 3 per cent tin was formerly used, but the antimony has been substituted at a great saving and with an improved result. The insulating material used in the cable has been the subject of a great deal of study. The material finally adopted is a thin, tough paper made from manila fiber. Worn-out manila ropes were found to be ideal for the purpose and practically all of the old rope from ships which was once thrown away now goes into the making of telephone cables.

As a matter of fact, although the line is practically completed and ready for service, engineers are still busy with investigations relating to it. One of these seeks to determine the effect of interference from electrical power lines which cross or parallel the cable.

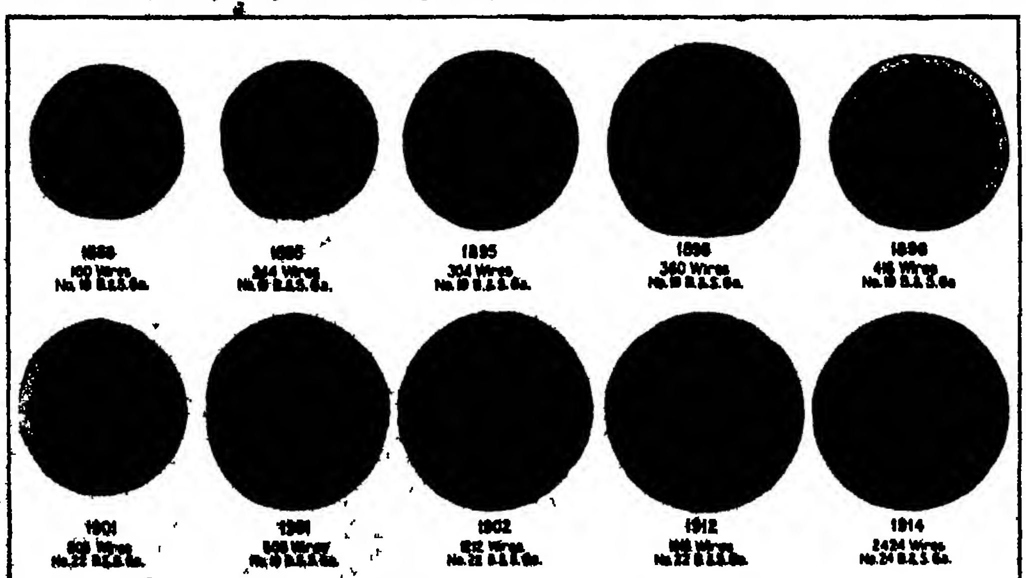
Our illustrations show, more clearly than words can describe, the physical difficulties of installing the great cable. Construction was comparatively easy where the right of way paralleled highways or followed old lines, but in places the telephone engineers had to make their way through a veritable jungle, where it was impossible even to walk without first cutting a path. Great reels of cable, each weighing more than two tons, had to be rolled and dragged to isolated mountain tops far from a highway. Caterpillar tractors solved this problem. There were not only mountains and valleys to be crossed, but rivers to bridge. As shown in one of the photographs, the cable parallels the open wire telephone line running from Philadelphia to Chicago, which it is expected will be partially dismantled as soon as the cable is in complete operation. The section of cable between Pittsburgh and Harrisburg is but one link of an installation which is being pushed rapidly further west and which will ultimately mark a new epoch in telephone service from Chicago, Toledo, Cleveland and other cities of the mid West to the cities of the East.



Section of a long-distance telephone cable, showing arrangement of layers of wire



The route of the big 'phone cable across Pennsylvania, and its connections



How cable capacities multiply as time marches on

Measuring the Growth of Trees

In the *Proceedings of the American Philosophical Society* for August 1921, Dr D T Macdougal gives the results of observations made with a dendrometer, on the growth of trees. It was found that the period in which enlargement of trunks takes place is comparatively brief even in places in which the season is of indeterminate duration. Growth is an activity of an embryogenic tract of tissue the activity of which depends upon environmental conditions, and no part of the observations suggested a seasonal rhythmic action.

The trunks of all the trees measured show a daily variation in size, by which the maximum is reached shortly after sunrise and the minimum at a time after noon dependent upon external agencies. These variations appear to depend upon the water balance in the woody cylinder, are greatest in the seasons in which water-loss from the crown is greatest are least in the cooler or damper seasons, and are to be detected in the records even in the period of most rapid enlargements of the trunk. The trunk of a tree may in fact, be compared to the supply hose of a fire engine coupled to a hydrant. When the pressure from the mains is enough to supply water faster than it can be pumped out the hose is distended. When the engine tends to take water faster than it would be delivered by the system, the hose would tend to collapse. Something of this sort takes place in many trees which have been kept under observation. The conduit in this case [illegible] is not a simple pipe or a set of pipes, but is made up of vessels through which water may pass under capillary conditions and enclosed box like tracheids which may be only partially filled with water. When water is [illegible] drawn from such a system faster than it is taken in the resulting changes in form and size are complex in character, but are expressed by the well-defined daily equalizing variations which are of a characteristic type for each kind of tree.

Awakening and growth of the terminal buds with resultant elongation of leaders and branches generally begins some time before enlargement of the trunk takes place in many trees. The period separating the two may in extreme cases be no more than a week.

The fact that growth depends upon physical conditions largely external in stead of being a manifestation of a rhythm on the part of the tree is well evidenced by tests in which trees which had ceased to grow with the seasonal drying out of the soil were awakened by the introduction of a renewed water supply.

The Yacht of a Viking Queen

By Charles d'Emery

THE mere mention of the word "Viking" carries with it visions of the daring navigators of the North, the men of Thor and Wodin and other gods of the Northland, and after one has sailed through the magnificent scenery of the fjords and felt their overpowering ruggedness, seen their sheer black walls of rock rising from the emerald depths of unruffled waters to their snow-covered tops thousands of feet above, one tries desperately to recall visions of those days when the fanciful prow of the Viking ships glided swiftly through these blue green waters impelled by rhythmic strokes of two score oars in the hands of weather beaten men, helped along perhaps by a huge square sail.

Viking days are comparatively speaking quite recent. It is less than a thousand years ago that Eric the Red crossed the North Atlantic. Many of the classic sagas of the Icelanders are of a much later date, yet there is very little left of these Norsemen that would give us a clear picture of their early days, and what there is has been carefully put together and preserved by the Norwegian Government.

In our own land we have relics of the ancient cliff dwellers dating back several hundred thousand years, but it is a long way from the dry clear atmosphere of our southwest to the rain and fog, wind and cold of Norway.

Under more favorable conditions we would no doubt have a great deal of material that would enable us to reconstruct much of the ancient life, for it was one of the Viking customs to bury their prominent dead in a ship which was sunk in the earth and covered with a mound. Within these burial ships were placed the choicest belongings, horses, carts or wagons, sleds, apparel, cooking utensils and quite often a living servant accompanied the master to the grave to minister to his wants in the halls of Walhalla.

It is only through a fortunate circumstance that there are any relics of this kind in existence, and that is due to the fact that in several cases the ships were buried in potters clay, which is particularly good for the preservation of wood. Under ordinary circumstances these burial boats have been totally destroyed by the dampness of the earth, only the rotted rivets gave any clew as to the size of the boats.

To date only three such boats have been found that could be reconstructed, the last one was found quite recently and it has proven to be the finest of the three. It is known as the Oseberg Ship, being unearthed in the place of that name in the province of Jarlsberg and Larvik.

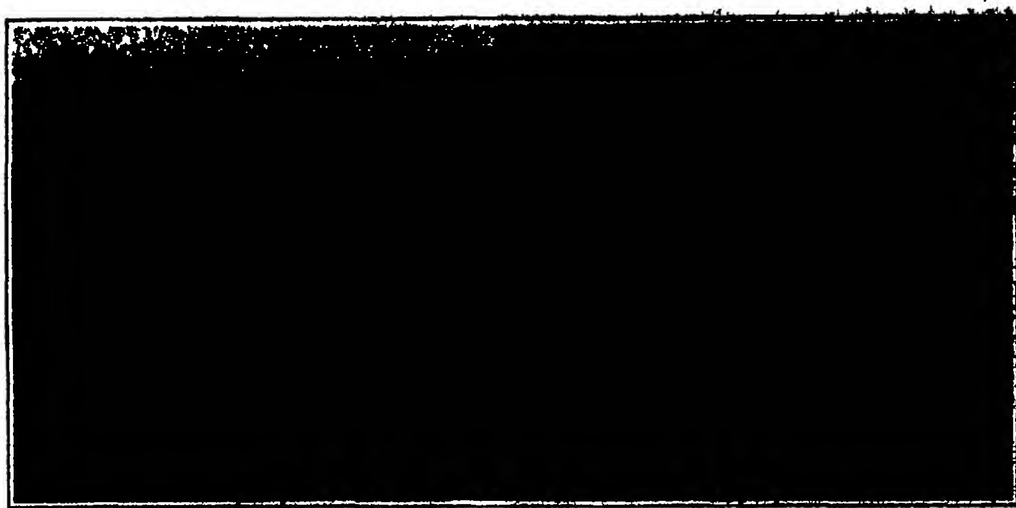
The ship was buried in potters clay and the mound was built of peat which formed an almost hermetic covering, thereby preserving all of the perishable material. Even the tracerics and carvings upon the stern and bow of the ship were untouched by the ravages of time. In the center of the ship was a well built sepulchral chamber filled with numerous articles. Feminine appliances of all kinds, spinning wheels, a loom for weaving, four sledges, several beds, a millstone, kitchen utensils, oak chests, feathers and down from pillows, balls of thread and wax.

In the midst of the sepulchral chamber were the remains of two females, one of them the distinguished woman who was thus royally buried and the other probably that of the maid who had to accompany her mistress in death.

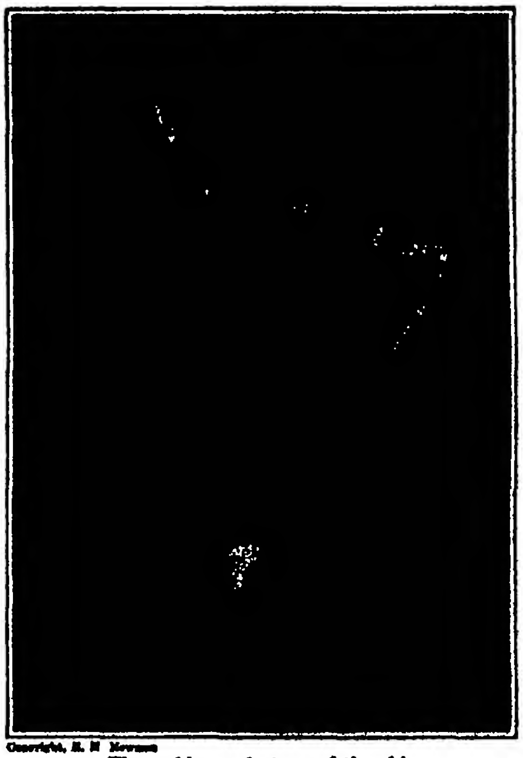
Valuable ornaments were missing and perhaps a great many other interesting things also, for the greater part of the chamber seems to have been removed by robbers, who had dug their way into the mound many centuries ago, fragments being found in the section of the ship where they had dug their way in. Hatchet strokes near the prow of the vessel told mutely where the robbers entered. Many splendid examples of early art, however, and relief carving of animal life were found. Around the outside [illegible]

The ship is [illegible] feet in length, 16½ feet in breadth and built entirely of oak. There are holes for the oars in the upper strakes, 15 to a side; there is also an appliance to hold the mast firm. The mast is set into the keel, but a large beam that runs across the ship close to the mast has been highly arched in order to form a higher and firmer support. The rudder is fastened by an osier band, and the rudderhead is kept in the gunwale by a skillfully plaited rawhide band. The ship is rather flat bottomed with a very fine sheer, giving the impression that she was mainly used as a pleasure boat in the fjords.

The age of this ship has been placed at about 1100 years, judging from the ornaments and carvings found within the sepulchral chamber. It was carefully unearthed and reconstructed bit by bit, for some of the ribs had to be steamed in order to restore its original form. It took nine months to complete this work, and the finished boat is now on exhibition at the University Museum of Christiania. All of the numerous contents may also be seen in one of the other Museum buildings there.



Copyright, E. M. Newman. Unearthing the Oseberg ship, a Viking relic from the eighth century



Copyright, E. M. Newman. The rudder and stern of the ship

Copyright, E. M. Newman. A section of the bow of the burial ship, showing the original gangplank

The Effect of Exercise on Blood Constituents

THE *Journal of Biological Chemistry* (London) for August 1921 contains an account of investigations made by Dr. N. W. Rakestraw of Leland Stanford University on the effect of muscular exercise upon certain common blood constituents. The investigation was undertaken on 21 human subjects to determine the changes produced by severe muscular exercise upon the following constituents of blood and plasma: Non-protein nitrogen, urea, sugar, uric acid, preformed and total creatinine, cholesterol and hemoglobin, as well as specific gravity, viscosity and the number and relative volume of corpuscles. As a result of his investigations the author finds that short strenuous exercise invariably increases the blood sugar concentration both in plasma and corpuscles, while a longer period of exercise is generally accompanied by a drop in blood sugar which was greater in the plasma than in the whole blood. Both kinds of exercise were accompanied by a small increase in uric acid, of about the same order, which was greater in the plasma than in the whole blood. Short strenuous exercise had no effect upon urea or non-protein nitrogen, but longer work increased both slightly in whole blood as well as plasma. In both types of exercise the total creatinine increased very little while the preformed creatinine underwent almost no change. There were no considerable changes in the total blood volume during the muscular exercise. It seems variations in the concentration of the blood are not therefore disturbing factors in the above conclusions. Cholesterol was found to decrease very slightly although results were not thoroughly consistent. The decrease seemed to be somewhat more noticeable in the corpuscles than in the plasma. The specific gravity, hemoglobin, and the number and relative volume of corpuscles were found to increase during the periods of exercise. The viscosity of the whole blood was found to increase considerably and that of the plasma slightly during exercise.

Some of the results obtained suggest that the total nitrogen is increased in the blood by exercise, and that urea, non-protein nitrogen, and uric acid continue to increase for some time after a work period, while the sugar concentration, on the other hand, returns to [illegible]

Left: The drum, with its projecting pins. *Center:* Close-up view of the phonograph motor, the record disk, and the sound-producing mechanism. *Right:* The complete recorder, with cover removed

Water-level recorder that speaks out and informs the engineer audibly of its findings

A Recorder That Speaks

IT is a matter of daily routine for engineers in charge of water-supply reservoirs or hydroelectric stations to have to ascertain at a few minutes' notice the state of the water-level of some distant and perhaps difficultly accessible tank or reservoir To help them in this work there have been adapted from instruments in use in chemical works, etc., certain warning systems whereby an alarm is sounded on the water reaching certain levels. These systems presuppose that the person interested is within earshot of the alarm, and also expecting it. Should he be absent, or preoccupied, and fail to hear the alarm, serious effects might ensue.

To obviate this there are a number of level-indicators which can transmit a record of the level of a water supply or other variable to any distance from the instrument itself. But it is a fault of these that it is necessary not only to install special receiving instruments at any point where a record is desired, but private wires as well. To overcome this difficulty a new type of audible recorder has been developed which necessitates no other apparatus additional to the transmitting instrument. This is allotted an ordinary telephone number, and can be connected with any telephone on the ordinary exchange. Thus the engineer or superintendent, wherever he may be, in his office or in town, can call up at any moment to far-off and inaccessible reservoirs (maybe among distant hills) and receive at once audible notice of the quantity of water in the reservoir, well, etc. The information is received direct, without the intervention of any human agency, thereby minimizing the possibility of error.

Two types of instruments are made. In the first a float on the surface of the water moves a cord attached to the instrument. This cord raises or lowers a contact arm fixed near a vertical drum This drum, as will be seen from the figure, somewhat resembles the selector gear used in automatic telephone exchanges. At 100 different distances from the bottom of the drum, corresponding with 100 different levels of the water from 1 foot to 100 feet, are pins projecting from the surface. When the instrument is "called up" from the exchange in the usual manner the drum commences to revolve, and the contact arm comes in contact with the pins projecting from the surface of the drum. A special selecting gear is provided to ensure that once the machine is in motion the arm can not alter its position until the revolution of the drum is complete. Each pin as it meets the contact arm causes a loud "click" in the telephone circuit. If, for instance, the water level stood at [illegible] feet, the engineer would actually hear clicks in the sequence:

— — — — — — — — —

This signal is repeated three times by the instrument, to obviate any possibility of mishearing. When it has been [illegible] the telephone line is automatically [illegible] and the instrument is again ready to be called up [illegible].

[illegible] of the same apparatus has been designed [illegible] to give the actual reading in spoken [illegible] a gramaphone mechanism [illegible] with the level-recording gear. As the [illegible] the needle and sound-box of the [illegible] over the record. The latter is [illegible] circles, and when the instrument is "called up" the needle is depressed on to the circle on the record which corresponds to the water-depth. The instrument reads from "empty" to "one double nought" by halves. If the water level were 42 feet, the engineer on calling up the instrument would hear a voice say

"Four two—four two—four two—etc." This would be repeated eight times, to ensure that there should be no mistake. Half feet are recorded, 42½ feet being vocalized as

"Four two half—four two half—etc" A special type of needles made of alloy steel is used, so that one needle serves for two thousand calls.—*By F A Rowlinson.*

The Friction and Carrying Capacity of Ball and Roller Bearings

TESTS, originally requested by the Navy Department, have been conducted by the Bureau of Standards, on the maximum safe load and static friction under load of ball and flexible roller bearings. The tests were quite exhaustive, and included balls, rollers, and races of different sizes and hardness. The results have been collected in the form of Technologic Paper No. 201 of the Bureau of Standards, obtainable from the Superintendent of Documents, Washington, D. C., at 10 cents per copy This paper should be of value to anyone interested in the design and use of these important types of bearings.

Portability and safety from shock are the features of this X-ray apparatus

An X ray Outfit in a Hand-Satchel

FANCY a complete X ray machine in a single unit the size of a portable enclosed typewriter Imagine a dentist or doctor carrying it to the bedside of a patient and working it from an electric light socket. Or a contractor locating hidden wiring and metal construction in walls and floors with it Whereas one of the smallest X-ray machines built before weighed 150 pounds and was in four units, this new machine is in one small steel can with bakelite cover and weighs 20 pounds.

But aside from its small size the apparatus has another virtue not possessed by its predecessors. Danger to both patient and doctor from contact with high-tension wiring is completely eliminated by enclosing the tube, high voltage transformer and stabilizer within this little oil-filled metallic case which comprises the the complete unit The presence of this machine in the scientific world has just been announced by Dr W D. Coolidge of the Research Laboratory of the General Electric Company

The new midget was built experimentally not merely to give the world a tiny X ray machine but to remove the element of danger from electric shock which has always attended the use of even the most modern X ray apparatus. And it has been successful

In order to protect against this ever-present danger the idea was conceived of putting the transformer and the tube inside a metal case and immersing them both in oil Thus there are no high-tension leads to contend with A wire carrying house-lighting current [illegible] 110 volts—runs from the lighting circuit to the X ray unit and the transforming is done inside the case

In order to make this unit most effective for dental service it was necessary to swing it at the end of a folding arm Necessarily it had to be small, so the size of the former types of transformer for X-ray use was reduced by about 50 per cent and the tube was reduced from 15 inches to 5¾—and other ingenious changes were made in the apparatus so that the whole unit was brought down to 20 pounds.

The two types of apparatus undergoing development include a 60,000-volt unit for heavier work and a 40 000-volt machine for lighter work The 60,000-volt unit is supported over the operating table by a stand similar to that used for the ordinary X-ray tube, but which permits easy movement of the whole unit. Neither the tiny 40,000-volt machine nor the heavier 60,000-volt unit is adapted to X ray treatment of disease. But they are effective for general radiographic work and they are absolutely safe, electrically

Tuolumne Canyon 4000 Feet Deep

TUOLUMNE RIVER rises in a group of glacial lakes on or near the Sierra divide in California. The river flows through beautiful upland meadows in its upper part and then through a canyon, nearly 80 miles long, which it has cut in solid granite. For a distance of about 25 miles, according to the United States Geological Survey, Department of the Interior, the upper part of this canyon is 3000 to 4000 feet deep and is known as the Grand Canyon of the Tuolumne At the lower end of this canyon lies Hetch Hetchy Valley, which is smaller than the Yosemite Valley but resembles it very much in every other way

Copyright, New York Times Co.

The closest photograph ever made of Mount Everest, taken from a near-by elevation of 22,500 feet

The Mount Everest Reconnaissance

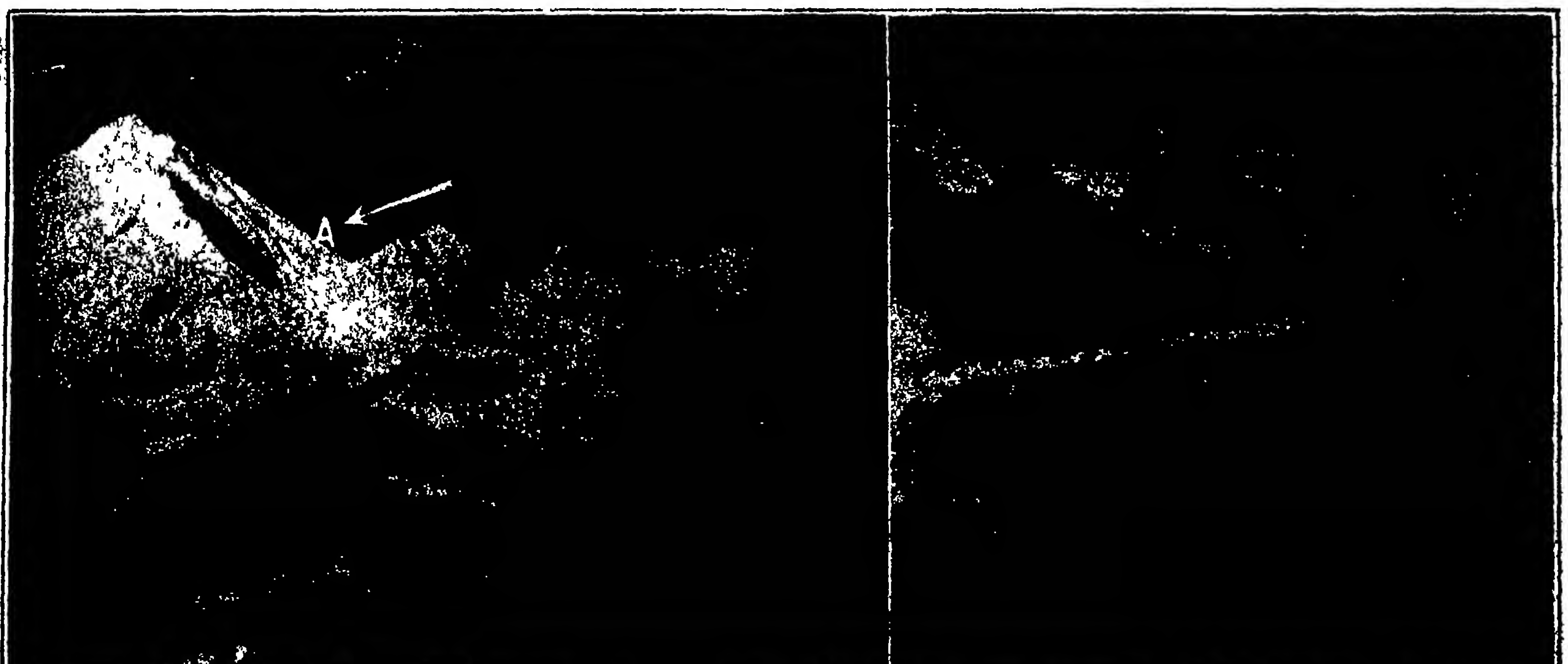
Further Details of the Effort to Locate a Possible Route to the Top of the World

UNDER this heading we summarized in our January issue the official information reaching us from the Mount Everest expedition The mountain had been practically circled and the closest scrutiny had failed to discover a possible route to the top, now, however, there is a different story to tell A promising path was found on the northeast scarp, and members of the party climbed it to within 6000 feet of the summit, only a series of violent storms preventing them from going higher Even though the resumption of the attack next season fails of reaching the apex, the undertaking has from the scientific point of view, richly repaid all efforts. One life was sacrificed to the cause, Dr A M Kellas had laid the party under a debt of gratitude for his knowledge of Himalayan travel and of the capacities of the native porter Worn out by previous exposure, he succumbed to the strain on June 5th, at Kampa Dzong

Mount Everest, towering 29 000 feet above sea level, perpetuates the name and work of George Everest, whose genius planned and largely carried out the survey of India It is particularly associated with that staggering geodetical feat, the measurement of an arc of the meridian on the great arc series of triangulation covering 1500 miles from Cape Comorin to Banog This triangulation is now being extended to the north and will conduce to a truer conception of the figure of the earth's crust and of the irregularities that cause the plumb line to deviate from its normal direction The season's work of the present expedition includes the mapping of more than 13,000 square miles of hitherto unknown and difficult country, with a photographic survey, one inch to the mile, of the whole Everest group, the geology of the district has been thoroughly investigated, and the long guarded secret of the age of the Himalayas has been read in the fossils found A huge collection of seeds is being brought from the valleys many of which are doubtless new

The return journey to Darjeeling led ten miles up the Arun valley, and followed the Kaichu for four miles to Lumeh, the poplar bridge here had been washed away, but the low waters were easily forded, and camp was pitched. Resuming the journey, a short but precipitous climb led to the Cuckoo Pass, avoiding an impassable gorge Six miles beyond was encountered the famous rope bridge, stretched between two twisted tree trunks anchored in piles of boulders. Passengers and baggage travel on a piece of wood pulled back and forth along the ropes. Midway across the stream, the ropes sagged so that the luckless passenger was sitting in the cold water, and the Tibetans thoroughly enjoyed the practical joke of holding the coolies of the party at that point until they were drenched by the waves and shivering in the chill wind It took half a day to complete the crossing Long marches brought them by way of Gyanganangpa, across the Tinki Pass, to Tinki Dzong Through blizzards with the thermometer at zero, crossing spurs 17,000 feet in height, the party pressed on to Darjeeling, which was reached on October 25th Gen C G Bruce will lead the expedition this year, starting in March, in place of Col Howard Bury, who was unable to resume the leadership this year

This summary would be incomplete without mention of the "wild hairy men" and "human footprints" that have been headlined and exploited by the newspapers. On the slopes of Everest the expedition encountered footprints of apparently human origin Some authorities account for these by the fact that this district is known to harbor a large species of monkey, the hanuman or lunger, being omnivorous, it could find plenty of food there However that may be, the Tibetans firmly believe in a race of wild men existing on the slopes of Everest, Chumalhari, and Karola, the coolies describe them as clothed only in their own hair, with feet turned outward. The only instance of a white man's glimpsing one of these "Abominable Snow Men," as the natives call them, is that brought forward some years ago by William Hugh Knight, of the Royal Societies Club. Near Gantok he found himself alone on an open clearing, the rest of his party having pushed on ahead, where he stopped to breathe his horse. Turning at a slight sound he saw a formidable figure some 20 paces away, gazing down the hillside Mr. Knight describes the wild man as pale yellow all over, almost stark naked in spite of the bitter cold of November, with a shock of matted hair, highly splayed feet, and large hands, one of which held a crude bow, he had the muscular development of a gorilla The figure soon disappeared down the hill, running at incredible speed. It should be said that the Tibetans drive their murderers into desolate places and forbid them any communication with law-abiding communities, it is within the bounds of possibility that the footprints seen by members of the Everest expedition, and the individual seen by Mr Knight, may thus be accounted for.



Copyright, New York Times Co.

Left: The northeast scarp of Mount Everest and its environs, showing the point (A) to which the expedition penetrated and from which a practicable path to the summit is believed to exist.
Right: The mountain from a point on the Rongbuk Glacier, about seven miles distant. This shows Everest from the north, where it is absolutely impregnable

Mount Everest from two angles, showing where it may and where it cannot be climbed

The Physical Basis of Heredity

Dominant and Recessive Characteristics: How They Arise and How They Work

By Prof. James B. Kelly, Pennsylvania State College

ONE must regret the ease with which a matter-of-fact attitude is assumed toward the truly wonderful things of our environment. Lists of the leading wonders of the world will include some large heap of stones in Egypt or some mechanism for utilising nature's forces, but will ignore such a really marvelous fact as the fact of heredity. Professor Brooks used to induce his readers to confer a proper emphasis upon heredity by having them first consider the complicated machinery of a modern steamboat and the nicety with which all parts work together for the propulsion of the whole. It is all very impressive. But then, he would add, suppose that it should be found while the boat was being studied that small bits of iron, without structure, are from time to time broken off and thrown overboard and that each of these contains within itself the power to build up all the machinery and appliances of a steamboat as perfect as the original—this would be like the phenomenon which is brought before the thoughtful in the word heredity Every plant and every animal, including man, starts existence as a relatively simple particle—a cell—that has not even the remotest resemblance to the adult that it will produce Nevertheless, through this reproducing particle, traits (or the factors that condition them) are carried on with remarkable certainty

Now it is well known that the bodies of the higher plants and animals are really each a great group of cells cooperating for the benefit of the whole The group had its beginning in the single cell already referred to as the reproducing particle Structurally this single original cell resembles any other cell It contains protoplasm, a white-of-egg-like substance with a machine-like structure The portion of the mechanism of interest to students of heredity is the set of chromosomes. Chromosomes are rod-shaped or thread like bodies, definite in number for a species and occurring in pairs. (*These facts are formally pictured in the accompanying diagram.*) Historically considered, however, the first cell or reproducing particle is unique, *for it results from the fusion of two other cells which are known as gametes.* One of the gametes, the egg, is contributed by the female, the other, by the male Gametes carry only half as many chromosomes as other cells of the species, and it is their fusion in the act of fertilization that establishes the paired-up condition of the chromosomes just spoken of (See diagram, figures 1 and 2.) The paired condition is remarkably maintained following fertilization in the cell multiplication that builds up the organism Only at its maturity do cells appear again carrying the reduced (half) number of chromosomes (Diagram, figure 4.)

It has long been known, among beekeepers at least, that the male bee or drone results from an unfertilised egg. In other words, the whole body of a drone is built of cells holding only the half number of chromosomes as is characteristic of gametes. A fact like this indicates that one set of chromosomes may contain all that is needful in order that an adult body be formed In general, however, *the cells of a plant or animal body* possess the double number of chromosomes whether they all be necessary or not

At this point it may be asked why a reader interested in heredity should be burdened with facts concerning chromosomes. The reason is this: a great body of genetical facts accumulated during the last two decades indicates that hereditary traits are conditioned by very small particles called genes or factors, and that these genes or factors *are carried by the chromosomes* in some sort of serial order As the chromosomes go, so go the contained genes, and one must be acquainted with the maneuvers of chromosomes in order to possess a philosophic conception of heredity

Since the chromosomes are in duplicate, the factors they carry are in similar condition, one of each pair of factors being contributed by the male parent, the other by the female. When we are dealing with pure-bred organisms the factors derived from the father are similar to those from the mother, and this prohibits us from, say, determining the relative importance of the paternal contribution and from tracing it through the children, grandchildren and subsequent generations. This is the reason why resort is had to hybridization, for, when the parents differ in one or more respects it is a simple matter to follow through in the progeny what each has presented at fertilisation. To make this matter concrete let us consider certain forms of the common annual Phlox. Most varieties possess

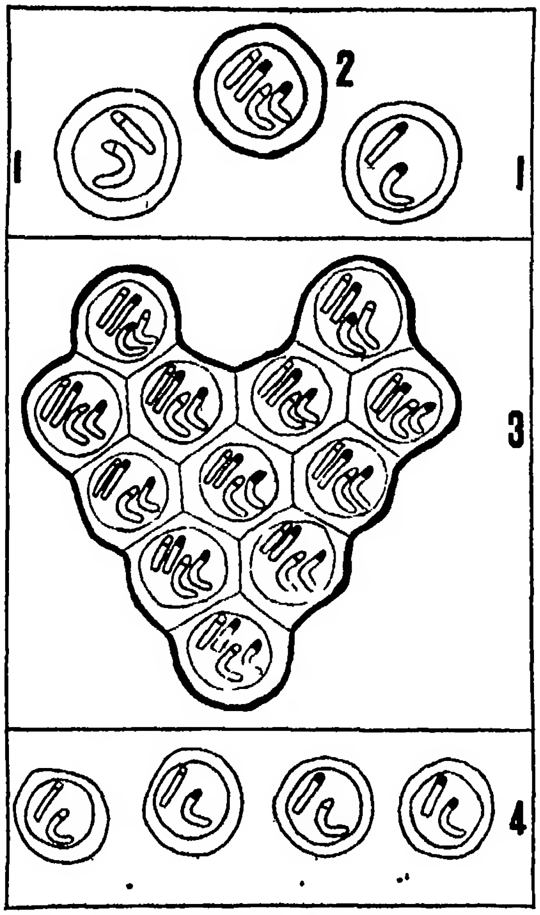
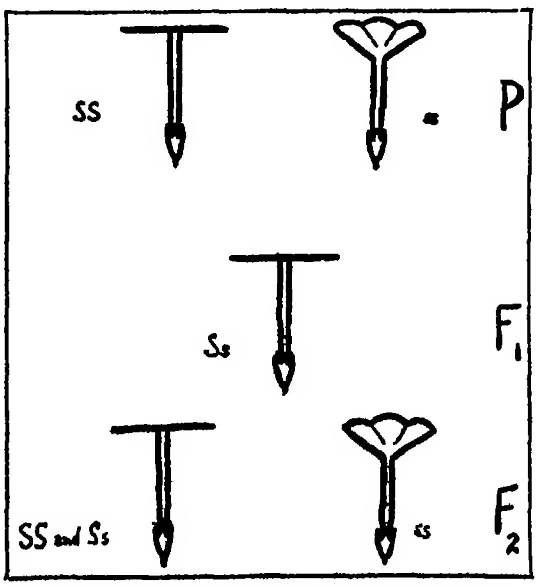


Fig 1: The two gametic cells, one male and one female two chromosomes being represented in each. Fig 2: With fertilisation the two gametes unite to form a single cell the fertilised egg. Fig. 3: The fertilised egg divides, as do its progeny again and again until there comes into being a large group of cells, the body of the adult organism. In all these cells the chromosomes remain in duplicate. Fig 4: In the sexual glands or in the spores, cells arise containing again but half the number of chromosomes. (Adapted from Genung)

The physical mechanism of reproduction and heredity



Upper line shows diagrammatically salver-shaped flower on left, funnel-shaped on right. When crossed, they produce salver-shaped offspring, as in the second line. In the third row we have the assorted second generation that springs from parents of the F_1 type

A typical chain of plant heredity

flowers which are salver-shaped, that is, each flower has the outer blade at right angles to the tube which supports the blade (Lower diagrams.) A few strains are characterized by flowers which in full bloom are funnel shaped Suppose these two kinds are crossed, which can be done by taking the pollen of the funnel variety and depositing it on the stigmas of the salver The children from such a mating—the first hybrid or F_1 generation—always look just like the salver-flowered parent, and there is no visible evidence of the funnel condition The salver shape is labeled a dominant, the other, as a recessive, trait Continuing such an experiment two of the F_1 salver-flowered plants are mated and give rise to a group of grandchildren called the second hybrid or F_2 generation This group is not uniform, but is made up of 75 per cent salver flowered *and 25 per cent funnel flowered* individuals The recessive trait reappears with all its original distinctness. These *facts are summed up in the diagram* The F_2 ratio has received a perfect interpretation on the basis of chromosome behavior We may picture in the cells of the original salver parent one pair of chromosomes carrying a pair of factors determining the salver shape Let us represent the condition by *SS*, where *S* stands for the gene conditioning the salver shape. Its reproductive cells, of course, contain but a single *S* each In the corresponding chromosomes of the funnel strain a different pair of factors, *ss* are assumed, which, when present in double dose, make for the funnel shape The gametes of the latter strain hold, each, only a single *s*. The crossing gives all the cells of the children (F_1) the composition *Ss* and the gene *S* alone determines the form of the flower These children will have, of course, gametes with the reduced number of chromosomes, and hence of factors. One-half of the F_1 gametes will carry *S* and the other half *s* In originating the F_2 generation—the grandchildren—by the mating of two F_1 individuals we really mix together for fertilization a lot of eggs, half carrying *S* and half *s*, with a lot of male gametes, likewise half with *S* and half with *s* Unions based merely on chance will give *SS*, *Ss*, *sS*, *ss* with equal frequency Only the *ss* combination will lead to a funnel flowered plant, and, as is evident, this will occur on the average only once in every four fertilisations. It is to be emphasised, by the way, that the figures "one in four," etc, given in this and other articles on heredity, are strictly averages, and are not to be interpreted as meaning that, if four offspring are produced, one will inevitably be of the character specified.

A number of comments may be made on the preceding simple case in the phloxes. The funnel characteristic is one that shows in the parents, becomes latent in the children thus skipping this generation, and it appears among the grandchildren Those grandchildren exhibiting it would be atavistic. The atavistic or recessive character is constant from the time of its reappearance and does not need to be "fixed" by further generations of inbreeding The potency of the factor for the funnel shape has not been altered by *hybrid association with a different sort of mate.* In fact, there seems to be no known sort of influence that may be employed to change the nature of a factor Henry Fairfield Osborn has recently stated that factors are the most stable things that he knows of in the realm of biology The chief of the Mendelian principles is this one concerning the association without contamination or change of pairs of factors in the body cells and of their pure segregation from each other when gametes are formed The three to one ratio among the grandchildren is dependent upon this hypothesis. It is also evident that there are two distinct types of the dominant characteristic, *i e*, the pure-breeding and the hybrid, distinguishable by the progeny they give The hybrid dominant carries along the recessive trait and gives no evidence of it on mere inspection. Feeble-mindedness in man, one kind at least, is a recessive characteristic, and this accounts for a feeble-minded child occasionally arising from two normal parents. The blue-eyed condition is similar and may appear among the progeny of brown-eyed parents.

Thus far our discussion of hybridization has dealt with cases in which the parent plants or animals differed in one pair of characters only We advance a step in complexity when we consider what follows when forms are mated which are distinguishable in respect to two pairs of traits. To revert to the Phloxes, let us suppose that a strain having flowers salver-shaped and colored is crossed to one whose flowers are

funnel-shaped and white. The immediate progeny from such a mating is uniform and exhibits the dominant traits, *color and the salver shape*. The generation of the grandchildren, derived as in the simple Phlox case, is a mixture In every 16 individuals there are *on the average*

9 colored and salver-shaped,
3 colored and funnel-shaped,
3 white and salver-shaped, and
1 white and funnel-shaped.

As an aid in visualizing the processes that underly this ratio, let us refer again to the diagram. Each of the chromosomes in the male gamete has a black mark in it Suppose the dot in the straight chromosome is the gene determining salver shape and the dot in the curved chromosome is the gene for colored flowers. The homologous chromosomes in the female gamete are shown without marks in the corresponding places or 'loci This signifies that they are carrying the recessive genes conditioning funnel shape and non-colored flowers, respectively (See Figue 1 in the diagram) Fertilization gives a cell (Figure 2 of diagram) hybrid in respect to two pairs of characters. The adult built up (Figure 3 of diagram) [illegible] colored [illegible] flowers and does not betray the latent genes for white and funnel shape carried in its constitution. With the formation of gametes by the adult (Figure 4, diagram) the usual reduction in chromosomes occurs. It is important to note that while rod chromosome always separates from rod chromosome (the two entering different gametes) and likewise curved chromosome separates from curved, it seems to be a matter of indifference whether the black-dotted rod passes into a gamete with the black-dotted or the non-dotted curved chromosome

The same holds good for the non-dotted rod. Accordingly four kinds of gametes are possible (Figure 4 of diagram), and the first hybrid generation forms these in equal numbers. Now suppose a lot of eggs of these four sorts are mixed with a lot of male gametes of the same sorts and the unions are left to chance. The laws of probability will lead us to the four combinations already mentioned as found among the grandchildren and in the stated proportions.

[illegible] principle of the [illegible] of the genes that condition them. If [illegible] flowered strain and the white [illegible] were the only kinds of Phlox [illegible] crossing would have enabled us [illegible] new creations, namely, colored [illegible] and white salver-shaped. All [illegible] as a collection of traits (dependent on a collection of genes in the chromosomes) [illegible] at time of gamete formation and capable of being put together into new combinations at times of fertilization. It is this principle which caused the botanist [illegible] that with a little time he could make [illegible] to order

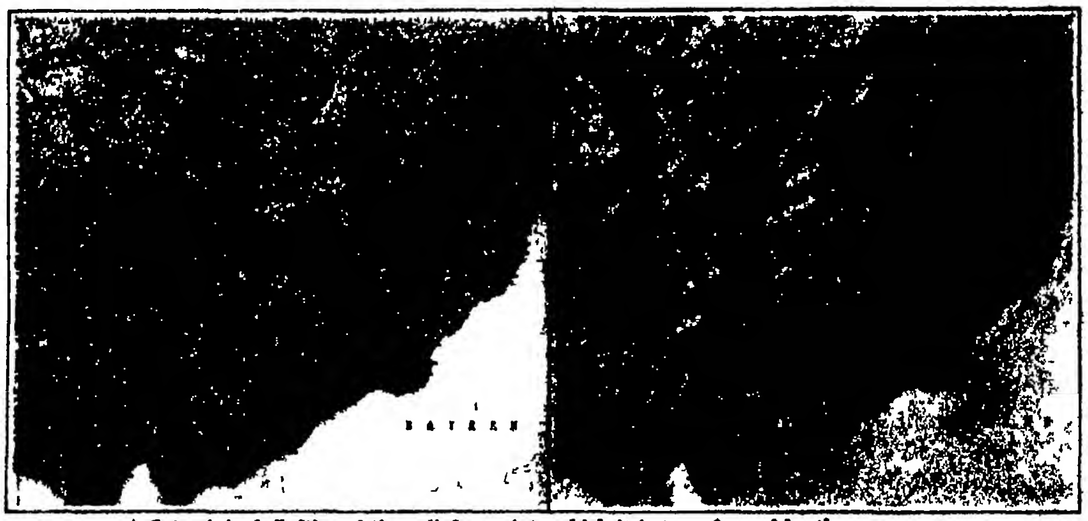
A large part of the success of Luther Burbank is dependent on securing new combinations of characters resulting from hybridizations. There are [illegible] refinements to the principle of [illegible], but all these are nicely interpretable in terms of chromosome behavior

Quantity Production of Relief Maps

A New Process Whereby These May Be Had Quickly and in Large Numbers

By Dr. Alfred Gradenwitz

INASMUCH as ordinary maps fail to convey any adequate idea of the ground they are intended to show endeavors have long been made to provide plastic maps, representing all three dimensions, *the heights* as well as the lengths and widths. Those so far produced, however, were anything but satisfactory If made of plaster of Paris, they would, in fact, be too schematical, of dimensions hardly ever true to scale and colors only seldom agreeing with natural conditions. Though these reliefs could be manifolded, two copies of the same original hardly ever agreed with one another, while each had to be separately painted and written on Other plastic maps were made up of a superposition of pasteboard (or wooden) sheets arranged in stair fashion unless the stairs were smoothed over with some plastic material, these would produce a wrong impression Moreover, all these maps were much too expensive to lend themselves to any large general use



A flat original (left) and the relief map into which it is transformed by the new process

A Munich sculptor, Karl Wenschow, has designed a radically new process for providing relief maps of surprising perfection and remarkable cheapness, in fact, any ordinary level map can by this process be converted into an excellent plastic map.

The map to be operated on is fixed in a frame providing the proper tension, after which it is placed above some plastic material and, by moistening with some special liquid, made ductile at any places corresponding to elevations or depressions of the ground. The map having then been pressed against the plastic mass, the heights and depths are worked out with special instruments in accordance with the altitude data of the map. The ductility of the map varies from one point to the other, any tearing or other damage being effectively prevented Ingeniously constructed apparatus allow the variable height of relief to be checked, ascertaining even the slightest inaccuracies. In fact, the level map is thus converted into a faithful model of the ground true to scale with regard to all its dimensions and angles.

The plastic mass above referred to enables even the most minute details, such as stone bridges, railroad lines, cuttings, to be worked out.

From this primitive mold, there is produced a counter-mold, destined to be used as matrix in stamping any desired number of replicas. Special stamping machines, working under high pressure, are used in this connection

For each plastic map to be stamped with this matrix, a level map is made ductile in the same manner as in connection with the primitive mold and is by the matrix pressed against an immediately hardening plastic mass. Stampings follow upon one another so rapidly that every five minutes a relief map is ready to leave the machine The latter is so designed that, while one mold is in the press, another can be prepared, in order on withdrawing the former, to be inserted without delay

Thanks to the stamping process, each relief leaving the machine is a perfect replica of the primitive mold, the surface of each being a pressed-on previously level map It is immediately ready for use and, as an improved map, it is suitable for a multitude of applications.

The inscriptions, colors and original proportions of the map are in no way altered by the treatment The relief map is hard as wood and of unlimited durability, neither its dimensions nor its volume undergoing any change in the course of time.

The process above described and the possibility of manifolding open up an enormous field of application, the extent of which cannot yet be adequately gaged.

Schools—elementary schools in the first place, but even secondary and high schools, universities and technical colleges—will derive much advantage from the new type of map. While the ordinary flat map frequently conveys no adequate idea of the conformation of the soil, plastic maps give a most vivid and impressive idea of everything pertaining to geography and lend a new and unexpected interest to a doctrine generally appealing to few pupils. Inasmuch as the plastic map is a perfect replica of the ground on a reduced scale, it is the most efficient means of studying it, even before proceeding to an inspection of local surroundings, enabling pupils to check and complete the knowledge derived from the plastic map.

Water, mining and harbor engineers will work much more quickly when planning and demonstrating their schemes with the aid of accurate reliefs. In fact, no better means of advertising a given scheme, or schemes of a given kind, can be imagined. While engineering diagrams with their calculations, ground-plans and elevations, profiles and financial estimates will always form the basis of any project, plastical maps are bound [illegible] to interest the man in the street in things so far reserved to a narrow circle of experts. Unfortunately, as is the case of most inventions, even military circles are likely to be interested in the process above described.

In the opening up of new countries, the new process will lend invaluable help, the more so as a combination of aerial surveying with the wholesale production of plastic maps has been attempted. In fact, the company exploiting the process has associated itself with the Aerial Pictures, Ltd., the Zeiss Works and the International Stereographic Central Station, with a view to combining their endeavors in the interests of culture and scientific investigation.

Whereas many decades would be necessary to survey (at an enormous cost) by terrestrial methods such countries as, *e.g.*, the interior of Africa, South America and Asia, the combination of aerial photography, photogrammetry and plastical map production will enable the greater part of the surface of our earth, which had so far been unknown, to be made accessible to mankind for the benefit of science and the progress of human civilization, thus utilizing values which it might otherwise have taken centuries to open up. Even before the colonist's foot shall have trodden the soil to be cultivated by him, he will be supplied with an accurate picture in relief of the area that is to be the scene of his future field of activity.

Gas-Burner Design

TECHNOLOGIC Paper of the Bureau of Standards No. [illegible], entitled, "Design of Atmospheric Gas Burners," describes the apparatus and methods used for the investigation of burner operation. Several [illegible] of gas orifices [illegible] and the [illegible] of discharge [illegible]. The principles governing [illegible] jection are [illegible] and examples and [illegible] shown to [illegible] the effect of a change in the [illegible] pressure, [illegible] and volume of gas. [illegible] sign of [illegible] tion of air [illegible] factory [illegible] described. [illegible] total port [illegible] and the [illegible] is fully [illegible]

Left: Revolving brushes neatly pluck the boll from the plant and bring it into position to be sucked up the flexible tube. *Center:* The picker at work in the fields. *Right:* Motors and control apparatus mounted on the tractor These motors clean the cotton before dropping it in the bags

The electric cotton picker, and some of its details

The Successful Cotton Picker

THE cotton industry, in which human labor has played the important rôle for the 4000 or more years that cotton has been picked by hand, promises to become revolutionized by the advent of an electrically operated picker, which has recently been perfected and placed in practical operation on a plantation at Little Rock, Arkansas, in the heart of the northern cotton belt.

This new electric device makes it possible for a person to gather from 400 to 700 pounds of cotton a day, as compared with 70 to 150 by hand. And by so doing it promises to solve the greatest problem of the cotton grower, that of being able to harvest all the cotton he plants and to do so during the limited period in the fall before the rains and frosts damage the plants and greatly lessen the value of the crop.

It seems odd, yet it is a fact that any cotton grower can raise about three times as much cotton as his hired help can pick. Unlike the harvest of corn, wheat and other crops, where a machine cuts down the stalks and makes but one trip over the field for a harvest, there are three distinct crops to the cotton plant. This means a harvest period of two months or more and thus eliminates the floating labor element and makes each plantation owner entirely dependent upon his own help to pick cotton. Outsiders cannot be interested because of the slow and tedious nature of the work, which brings such small returns and has always been the task of the negro.

This is but one feature of this twentieth century picker. Other points in its favor are not to be overlooked. Thus, it will result in cotton being picked when ripe, thus improving the grade two or three times and adding $10 or more to the value of a bale. By hand, but half the cotton of the South is being picked on time before it has deteriorated in value because of weather elements.

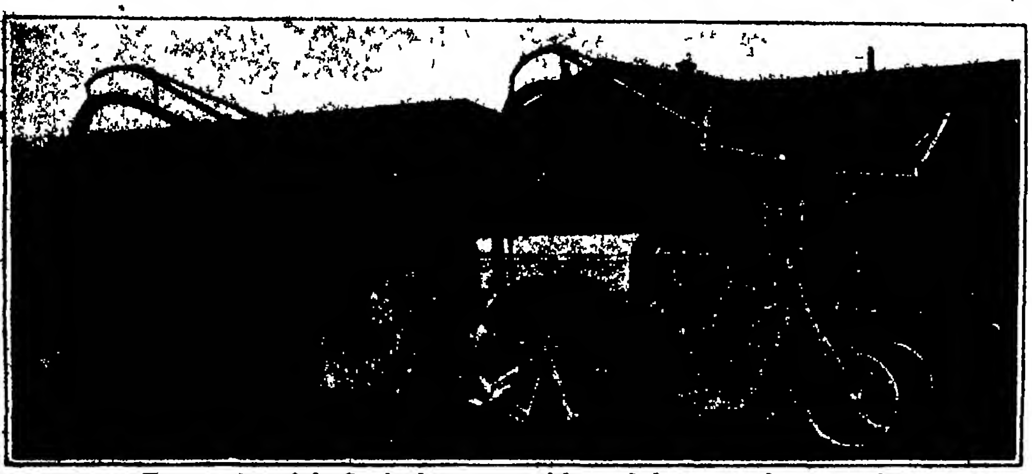
This latest attempt to replace hand picking may be called the life work of L. C. Stuckenborg, of Memphis, Tenn. He admits that he received his real inspiration leading up to the perfection of the present machine, when watching a cow which had broken down the gates and wandered into his cotton fields. Cows will eat cotton for the seeds imbedded in the fiber, and as this cow went from plant to plant, he noted the ease with which the cotton was removed from the bolls [illegible]

[illegible]

size of a man's double fist The brushes were made to revolve inwardly, thus creating a comb-like movement and when these were placed against the cotton, pulled it free from the bolls without collecting any part of the boll or leaves of the plant Then, having solved the plan for removing the cotton, he adopted the much tried suction idea for carrying the cotton to the receptacle to receive it. A flexible tube connecting with a bag on the machine did the trick

Each machine carries a complete electric power plant The tractor engine furnishes sufficient electric power to operate the eight motors required to run the machine The brushes in the leads are driven by a flexible drive-shaft about three feet long, which is connected to a small motor suspended about half way down the suction tube After the cotton completes its trip through the tube and just before it drops into the bag, it is given a cleaning by fanning, another motor operating the blower as well as providing suction power

There are four picking tubes to a machine, each with its pair of motors. Supported overhead by a balance arrangement, the pickers are suspended with such lightness and flexibility that even a child could shift them about with ease The machine as it passes through the field can pick eight rows The negro—and several have been tried on the machine—finds no trouble in using it, and in checking up his work it has been found that where he formerly picked 100 pounds by hand he has, with only a few days training, been picking 400 pounds by machine

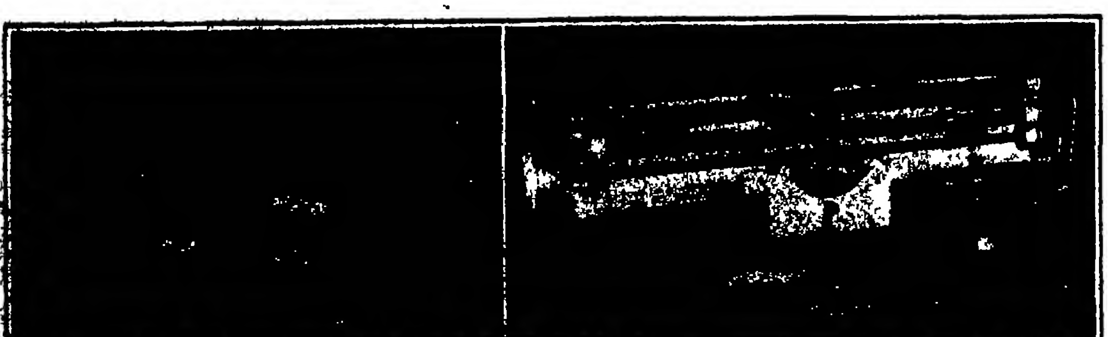


Close-up view of the Stuckenborg cotton picker and the tractor that carries it

The Braille Typewriter for the Blind

THE Braille alphabet for the blind is essentially no different in its major features, from any other alphabet A character for each sound—that is the ideal toward which any alphabet more or less closely approximates. But mechanically speaking the Braille alphabet is very different from any other There is no particular connection between the individual letters of our ordinary type or script The Braille letters, on the other hand are consciously and deliberately built up from six simple elements. These elements, instead of differing in shape consist every one of them of a single dot identical except for the single characteristic of position If we take the six spot on a domino or one of the six spots in a deck of cards we have the whole thing there before us. And since each dot affords us the alternative of its presence or absence we can make of the whole six exactly 2x2x2x2x2x2 or 64 different combinations of dots, each combination containing perhaps six dots perhaps five, or four three two one—or in one case none at all Excluding so far as possible combinations which might be ambiguous to the reading finger there are plainly enough combinations to represent all the letters and to give a surplus for use as arbitrary symbols.

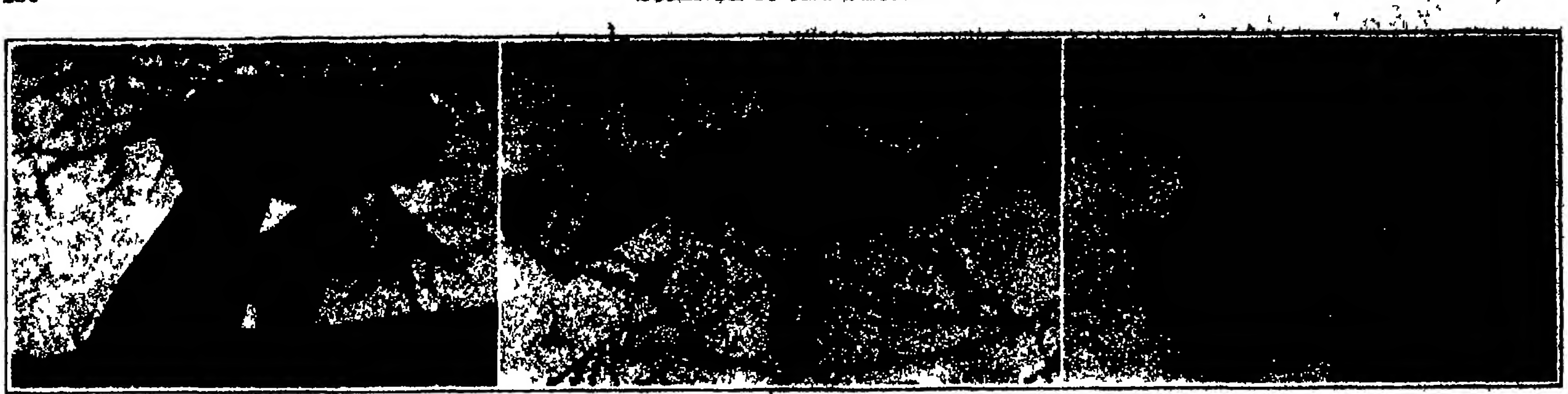
But the fact that the alphabet is so definitely composed of a small number of elements influences [illegible] the design of all typewriters [illegible] the blind, one of which of French make [illegible] we illustrate With a separate key for each letter there is a certain operating simplicity But with a key for each of the component elements of the letters the constructional simplicity is so great, and the machine so compact, that the objection against the necessity of striking three or four keys to complete the representation of a single letter is of no weight Therefore we have the Braille typewriter with six printing keys, one for each of the six positions in which it can be desired to strike a dot, and, in the middle of the group, a space key which shifts the paper when it is time to pass on to the formation of the next letter With the further remark that the machine is really an embossing rather than a printing one, that is all there is to it



Front and rear views of the typewriter that prints Braille letters for the blind

Low-Pressure Safety Valve

SAFETY valves designed for low pressure are important for certain uses. It is desirable that such valves open at a predetermined pressure and seat tightly so as to minimize leakage A new form of safety valve to fulfill these requirements has been designed and constructed by the Bureau of Standards.



Veiltail, a modification of the goldfish — Goldfish, common carp var auratus — Egg fish, var oviformis of the goldfish

[illegible]ree variations of the common carp, Carassius vulgaris, all of them being goldfish of plain or fancy type

From Common Carp to Fanciest of Gold Fish

Some of the Wide Variations Which Are Comprised Within a Single Scientific Classification

By Ralph Howard

ANIMALS which man has domesticated and which have multiplied under his supervision often differ considerably, not only in their form but also in their characteristics, from their wild relatives, so that it is often difficult to determine with any degree of accuracy the origin of the animal in question. The goldfish is a descendant of the crucian carp (*Carassius vulgaris*) which is found in the slow running and standing waters of Europe and West Asia. In its typical form, this fresh water fish has a prominently curved back, and as such it inhabits the larger lakes. In its other form it is more elongated and slender, this is the so-called "hunger" form, and as such it inhabits the smaller ponds. From the latter form the goldfish has been developed.

The carps, and especially the crucian forms, possess the characteristic of taking on a more or less intensive glaze, the fish being then colored red or yellow. This means that inceptive albinoism is a trait, true albinoism, a white coloration being seldom observed in aquatic animals. A yellow coloration is scientifically known as xanthochroia, here the dark cells are filled with a more or less intensive yellow pigment.

The yellow color, noticed by the Chinese, was the starting point of a golden yellow crucian carp. Then, through observation and selection of those fish which happened to possess a different color and those which had the desired shape in the highest degree, the goldfish was slowly developed. But this again was the starting point of still other races which often had the most bizarre shape, and artistic form, and these are the ornamental fish which are so universally liked.

Of those forms which have been developed from the goldfish the most common are the veiltail, telescope, telescope-veiltail, egg fish, lion head, celestial, and comet. The comet has a simple caudal fin which is broad and long, in all other forms or races this, as well as the anal fin, is doubled, the rest of the fins being abnormally large. The doubling of the fin is explained by the fact that, in the embryo stage, the fins are in two symmetrical halves which, under normal conditions, grow together. If this does not happen the fins of the fish remain doubled. At the same time the skeleton is extraordinarily changed in its structure, the bones being paired. No other free living fish is so characterized. Veiltails have also been developed which have had three tail fins, the center one being normal, while the two others were placed on each side.

The full beauty of the veiltail is developed in the second year. Perfect specimens must have an entirely divided tail fin and it should be a delicate long veil like structure hanging downward. The anal fin must also be doubled. The dorsal fin should be high and long, and the other fins should also be peculiarly placed. The telescope veiltail must have, in addition to these peculiarities, well-developed eyes placed on a tiny eminence so that they protrude from the head, giving them the appearance of small telescopes. It is interesting to observe that these fish can be perfectly black, a characteristic which has been but seldom observed and is known as melanism.

Lion heads, egg fish, and celestials do not possess dorsal fins. Their other fins are not particularly enlarged, but their anal and caudal fins must be doubled. The older lion heads are characterized by fleshy protuberances over the head. The lion head and egg fish differ from the celestial in that the latter has eyes resembling those of the telescope, but with their pupils placed in such a position that they can see only upward.

Of all these various races of goldfish, species have been developed which not only have their normal scales, but which, as the fanciers say, are scaleless. But this is not an absolute fact since the scales of the latter are in such a condition that they are scarcely visible, and being without pigment they are often as clear as glass.

All goldfish races are deformed. In fact this is more than a mere deformity for the swollen belly, the protruding eyes of the telescope and the celestial, the doubling of the fins, the lack of dorsal fins in the celestial, and the lion heads, are produced through a disease which is transmitted from generation to generation, and is called yolk weakness. The embryo of these races have the sickly property of absorbing water into the food storing yolk.

The breeding of these goldfish types is not at all difficult in the balanced aquarium. As a rule two males are placed together with one female. The sexes differ at their anal part, the female having a short, slightly protruding egg tube, while the male has a slight notch at this particular spot. As soon as it becomes warm the breeding season sets in. The males begin to drive the female, the loveplay lasting some time. Finally the female lays her eggs in the delicately feathered water plants. When the spawn has been deposited the parents should be removed from the aquarium.

The young hatch in from three to eleven days, and they should be placed in an older aquarium where the glass has become coated with algæ. Here a sufficient supply of infusorial food will be found by the fry. After 14 days the young fish are too old for this tiny food, they then require larger crustaceans such as *daphnia* and *cyclops* which inhabit all of our ponds and lakes. This is the natural food for them and they will thrive amazingly on it.

Older species should not be fed with live food, as this may cause an accidental introduction of parasitic diseases. It is better to provide them with raw, scraped, lean meat, small earthworms, and a better grade of the artificial fish foods found on the market.

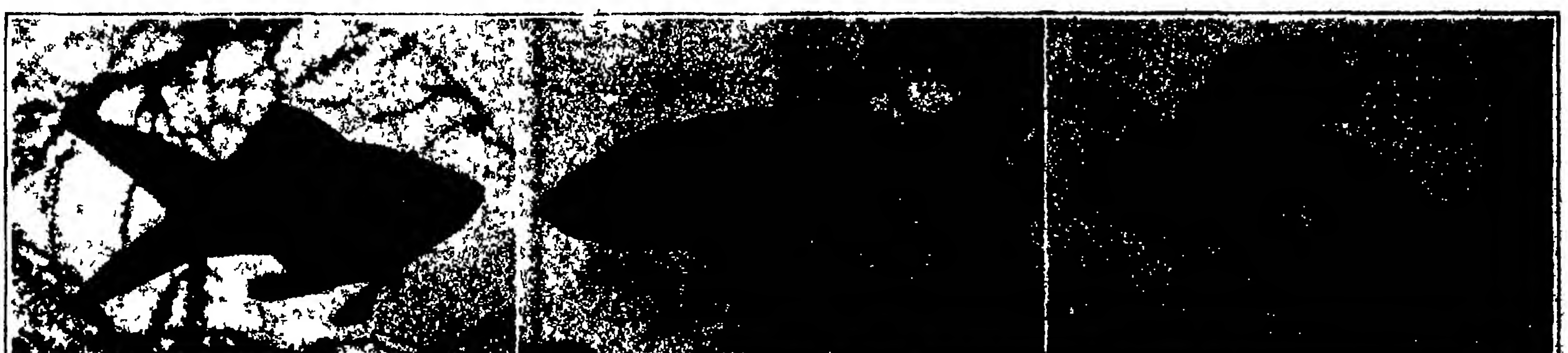
For the successful development of these fish no elaborate aquarium is necessary. They are satisfied with a simple tank provided with growing water plants.

The eye must first become accustomed to the peculiar racial characteristics of those highly developed and specialized animals which man has formed before they can be appreciated. But under no circumstances can it be denied that these products of selective breeding are unique and grotesquely beautiful. And in addition to this the care of such animals, and their breeding in the naturally balanced aquarium is full of fascination.

Paris Technical Conference on Radio Regulation

DURING the past summer the principal nations have been represented at a conference having for its object the formulation of regulations governing the use of radio by different nations.

Two delegates from the Department of Commerce were present at the conference, and various important rules were laid down. These include, recommendations as to the frequency of waves which shall be used for various distances, the use of similar frequencies by stations in the same locality, the employment of the least possible number of wave lengths by each nation, and the recommendation for the utilization of the directional properties of radio. These recommendations, however, are not binding upon any of the nations which were parties to the conference.



The comet, or Japanese goldfish — The plain, unvarnished, common crucian carp — The [illegible] telescope

Carassius vulgaris himself, and two more of his offshoots

Making Tea from Holly

By S. R. Winters

A SPECIES of holly, growing riotously over 40,000 square miles in the South Atlantic and Gulf States, may in the not remote future be converted into a beverage in quantity production. George F Mitchell, tea specialist of the Bureau of Chemistry, United States Department of Agriculture, has correctly appraised the value of this native plant, sometimes called cassina, as a stimulating drink similar to imported teas and coffees. This shrubbery, with its brilliant red berries and evergreen leaves, grows wild over an area extending from the James River of Virginia along the coast of the Southern and Gulf States to the Rio Grande River of Texas. The plant, at present, has wide appeal for decorative purposes and as Christmas trees during the festive season.

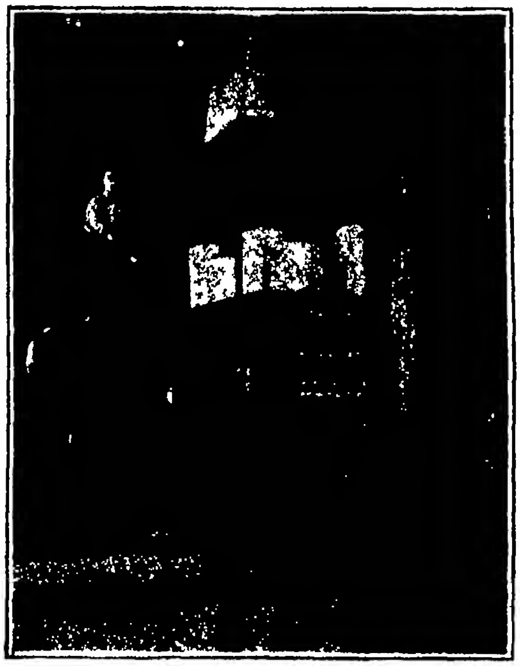
The use of this species of holly as a beverage is not a modern discovery. Its use by the Indians is most interestingly described in publications by Dr W E. Safford of the Department of Agriculture and also by Dr E. M Hale, formerly in the service of the Government, and in a crude way a drink has been made from holly in Southern homes from earliest recollections until the present day Chemical research, however, had failed to establish the caffeine content of cassina until 1872.

The exigencies of the World War were cause for a renewal of scientific research on the subject Responsive to a request from the National Research Council for a native source of caffeine for medicinal and chemical purposes, Dr Frederick B Power and Victor K. Chesnut of the Bureau of Chemistry, United States Department of Agriculture, focused their attention on the berry-producing holly Samples of the leaves analyzed by these chemists evidenced as high as 1 65 per cent of caffeine It remained, however, for George F Mitchell, tea specialist of the Federal Government, because of his knowledge of cultivation and manufacture of tea, to appraise the commercial possibilities of the riotous growth as a beverage. The application of scientific methods, according to his belief, in the curing of the holly leaves and in the manufacture of the beverage seems to promise, on a commercial scale, a native drink of rival popularity to imported tea and coffee. Laboratory experiments in Washington and reinforced observations in the South during the past summer, seem to indicate that a delicious drink can be produced.

Simple ways of harvesting and manufacturing the leaves of this species of holly into a beverage are in the interest of economy of production All of the leaves contain caffeine. The system of planting and pruning commercial tea plants in Japan could be duplicated to advantage. Hedges can be cultivated, a practice observed in the South where effective windbreaks are desired. Young plants, under cultural conditions, grow about five feet the first year Prunings would be desirable once or twice a year, the offshoots and leaves being converted into tea. The second year the new growth could again be separated from the parent plant, the pruning being a few eyes above the old wood. This practice obtains in the culture of tea-producing plants in Japan. For ten years this procedure could be duplicated; after then the plant would involve "collar pruning," a cutting off of the shrub even with the ground so as to make way for a new and virile growth. The holly branches may be divorced from the parent shrub either by hand or machinery.

The tea as now being concocted from cassina in the laboratory of the Bureau of Chemistry is of two colors, one being dark and the other of a greenish hue The manufacture of the former on quantity production involves the stripping of the holly leaves from the branches previously pruned and rolling the leaves in a tea-rolling machine. This procedure does not curl the leaf, as is true in the production of imported tea, but shatters the cells of the leaf, thus turning loose the juice of the plant. The leaves are fermented from three to eighteen hours, after which they are dried at a temperature of 280 degrees Fahrenheit in a conventional tea-drying machine. Subsequently the leaves are equalized in a machine resembling a coffee mill. Then the finished product is marketable. The drink is concocted in a fashion known to homes in making coffee—either boiling the shattered leaves for two minutes or percolating for five minutes. If the holly leaves are to be converted into a tea of greenish color, stripping of the leaves from the branches is unnecessary.

Type of tea-rolling machine proposed to be used in the manufacture of cassina



The tea-drying machine which it is planned to transfer to the production of cassina

Chemistry, in the process of destroying the oxidizing agent with live steam, detaches the leaves from the stems. Or, in the absence of this effectual agent, the stems can be removed in a manner similar to that of the farmer threshing cowpeas. Thus the cost of manufacturing this new drink of a greenish hue is reduced to a minimum. Beverage from cassina, on a commercial scale, may be produced by the conventional machinery known to the manufacturers of tea in Japan. The units of machinery, however, may be curtailed materially in the production of a drink from holly

Holly known as the "Christmas-berry tree," grows luxuriantly and riotously in Virginia, North Carolina, Georgia, Florida, Alabama Louisiana, Mississippi Texas and South Carolina Other than its frequent occurrence in a wild state, there are cultivated hedges serving as windbreaks on farms and as ornamental groves. Plans of the Department of Agriculture already contemplate the propagation of this species of holly from both cuttings and seed The latter method has not heretofore been attempted. The abundance of wild growth, scattering as it is over a wide area of fields and forests, lends itself to one essential objection, namely, it would have to be gathered by pruning with hand labor Cultivated hedges, according to those familiar with tea culture, overcome this criticism inasmuch as the leaves and branches can be harvested by machinery The latter feature contributes to the economy of manufacturing the beverage Community factories, which would utilize prunings from the riotous growth as well as cultivated plants in the making of beverage, is the ultimate objective of the chemists.

Thistle Gardening in San Francisco

By G A. Orb

IN the backyards of San Francisco and the Half Moon Bay region we find a giant thistle being cultivated for its food value—a giant thistle of Mediterranean origin with spines which are both relentless and cruel but a large purple flower most gloriously scented which holds an irresistible lure for the bees, a giant thistle which so loves its adopted home that it refuses to be grown elsewhere in spite of the many attempts to do so

This same thistle with its wonderful, big buds and great Corinthian leaves with their prickly spines, is known to the consumer as the artichoke, and such a delicacy do we regard the bud of this same flower that it sells for a higher price than the famous Hood River apples, Fresno raisins, Florida oranges, or Santa Clara apricots Indeed, in our cities not only do we find it displayed in the fancy grocery but not unusual is it to find the push-cart peddler devoting a part of his limited space to the same delicacy, and both the rich man and the poor man buys it—often paying as high as a quarter apiece

We might perhaps better speak of this unique industry as floriculture rather than as market gardening, but by whatever name we call it California reaps the nice annual return of better than a million and a half from it The artichoke season begins early in the days of October and reaches its crest about the first of April nor accidental is it that it should reach its height just at the time when it will make the most definite appeal to the city consumer St Louis, New Orleans, New York, Chicago, as well as the cities along the Pacific slope, all draw their supply from San Francisco From this region (and the land just a few miles south) there was shipped last year some 500 carload lots 350 of these went to eastern cities, and 150 to cities along the Pacific slope, while of course, San Francisco itself is a big consumer

Twenty five cents apiece does not seem such a high price to pay for this delicacy when we stop to think that it must go on the market in the middle of the winter when the appeal to the popular taste will be most powerful, and when we realize what a back breaking job it is to carefully prune and cultivate the plant so that it may break forth into blossom at just the identical time we desire, and that this same blossom shall hold all of the delicious succulence which makes it so loved. The grower cuts back his plants in June and it is marvelous how soon after the plant has been pruned to the very ground the great new leaves and sturdy flower stalks make their appearance And if it be given plenty to eat—for it has a ravenous appetite and must have plenty of fertilizer, plenty of water, with long days of bright sunshine and a rich black loam soil—it will be most accommodating and bud and blossom just as the gardener would like. But woe betide the gardener who cuts down the ration!

An artichoke garden, showing the big buds and the great leaves with their prickly spines

Roentgen-Ray Photography

Some Recent Applications of the X-Ray, and Some Bizarre Results

By P. J. Risdon

SOME interesting research work has recently been carried out in connection with the application of X-rays. Dr Heilbron of Amsterdam, among others, has proved that in the world of art forgeries and alterations to pictures can be detected with ease—a much-needed protection for those whose taste lies in the direction of "old masters." Dr W F D Chambers has turned his attention to experimental work in connection with the nature of the rays, and from a scientific point of view his discoveries are of importance. Fig 1 represents a thick lead sheet (which is impervious to the rays), out of which narrow, triangular sections have been carefully cut. There was no apparent reason why the shadows should not have been identically the same along each side of each of the triangular slots. A number of photographs resulted in the curious shadow effects shown, which prove that the rays vary according to the angle at which they leave the anti-cathode. Upon striking the object perpendicularly, rays leaving the anti-cathode at a certain angle were deflected by the object, producing the one-sided shadow effect. Rays proceeding from the anti-cathode at another angle produced an almost symmetrical effect.

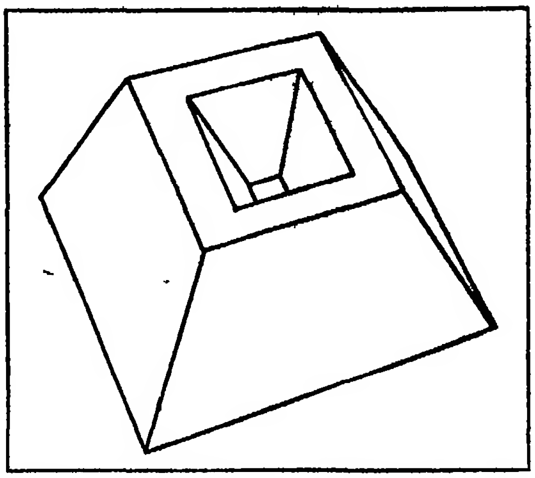
In the case of an X radiograph of a lead disk in different positions in relation to the cathode of a Coolidge tube, the asymmetry of the rays is again made manifest. The disk was not moved, but the Coolidge tube was pivoted so that it could be turned, and the rays proceeding from the anti-cathode at different angles could be directed perpendicularly upon the disk.

Fig 3 is an X radiograph of a model of paraffin wax, shown in line in the center of the page. It will be seen that the edges of the convex surfaces show up as white bands and the edges of the concave surfaces as black bands. It is supposed that these effects are produced by excitation of the photographic plate by the rays (after passing through the object). Dr Chambers claims to have proved that these "characteristic" bands are not due to lens distortion, as was previously supposed, since his experiments were made without lenses.

In illustrating an astonishing effect of rediffraction of X-rays two large lead plates were used. In the center of the one nearer the tube a pinhole was made. In the center of the other plate, which was placed a short distance away and parallel with the first, a similar hole was made, and round it 8 holes 2 mm diameter. The direct rays of the "pencil" formed by the pinhole in the first plate passed through the central hole in the second plate, so that only diffracted rays acted upon the second plate. The surprising result was that each of the eight circular holes appeared on the photographic plate as black and white lines forming two sides of a square. Had they appeared as two parallel lines the effect might have been ascribed to polarization, as it is, no explanation has yet been offered of the result beyond the suggestion that the rays may be divisible. Only faint traces of the eight holes in the second plate were detected. We may almost expect to hear next that Dr Chambers has squared the circle with his X-ray machine!

As another illustration of the effect of asymmetry and of diffracted rays, rays diffracted by a lead disk and falling upon another lead disk with six circular holes in it resulted in some curious photographs. In one case all six holes appeared curiously distorted. In another only four out of the six appeared at all.

The application of X rays in the realms of commerce is far from uncommon. In the examination of materials for flaws and other defects it is unnecessary to take radiographs except when imperfections are discovered. The article is merely placed in position and visually



The wax model of Fig. 3 below, showing its true form

examined. There is practically no ordinary article of commerce now, except lead, which is impervious to the rays.

Fig 2 is a radiograph of a weld in a steel bar showing imperfections in welding. The white patch is a cluster of air spaces. The rays are capable of penetrating half an inch of steel. Imperfections in airplane spars are similarly detected. The rays penetrate 12 inches of wood with the greatest ease. The sample spar was planed perfectly smooth and the grain is seen to be straight and even. But if there should be an internal knot, shake or crack, it would distinctly appear in the radiograph.

By way of showing how easily the rays penetrate aluminum, in a radiograph of the head of an aero engine one may see the core wires round which the metal was cast.

Of a very different character are some excellent X-radiographs of medical subjects by Dr. Robert Knox, of London, some of which were taken with an exposure of a second or two as compared with 20 minutes in the early days of X-radiography. One shows the disposition of bones in a pair of small feet. Another is of a fractured femur, during the process of healing, showing how the two halves unite and grow together again. In a third, a mottled, egg-shaped patch is a collection of stones in the gall bladder of a woman. As may be supposed, it was a serious case.

An interesting instance occurs of the application of the rays in connection with appendicitis. As a rule, in a radiograph the appendix would scarcely be perceptible; it is only when filled that it shows up dark, with a slight break between the solid contents. Again, where normally the lungs should appear almost white, in the case of a patient in an advanced stage of consumption the lung on one side is useless, while the mottled appearance of the other lung indicates a serious condition. In this view the ribs show as dark bands.

An X-ray view of special interest to horticulturists is a radiograph of a cluster of flowers. This application of the rays opens up the possibility of detecting and studying diseases of plants and flowers.

For permission to publish these pictures our acknowledgment and thanks are due to the Roentgen Society, London; Dr. Robert Knox, Dr. W F D. Chambers and the Cox-Cavendish Co. of London. It is to be regretted that, on grounds of space, it has been necessary for the editors to exclude some of the views put in their hands by the author, and to refer to these through textual description alone.

How to Get Better Service with Less Natural Gas in Domestic Gas Appliances

MANY of the towns and cities of this country are dependent upon natural gas and are not provided with artificial gas plants. It is estimated that if the sources of natural gas should become exhausted, it would take $1,000,000 worth of artificial gas per day to replace it. As natural gas is an extremely limited resource, the greatest interest should be shown in any means for lessening its consumption, provided good service is still rendered.

Circular No 116 of the Bureau of Standards, issued by the Superintendent of Documents, Washington, D C., at 5 cents per copy, describes ways in which better service can be obtained by slight modifications in existing appliances. It is shown that by proper location of a burner and by the use of open-top stoves only one-fourth of the present amount of gas will be needed to render even better service than is now obtained, lower pressures could also be employed, thus lessening leakage and its attending waste.

Fig 1 Demonstrating that the angle of leaving the cathode is partly determinative of the action of the rays

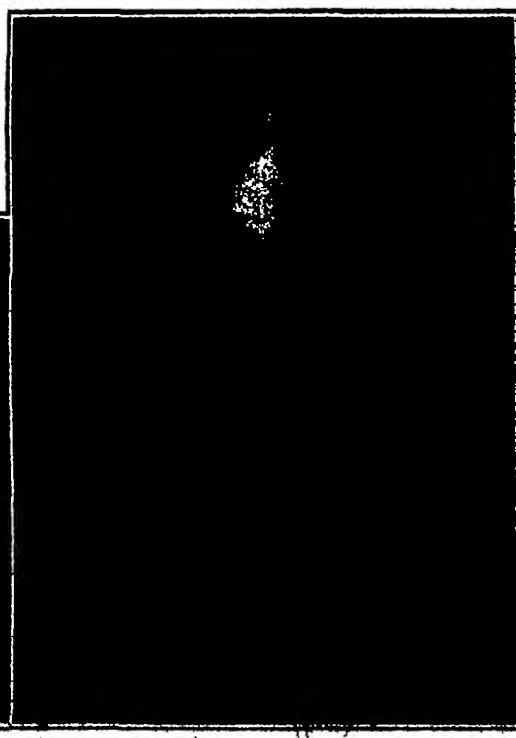


Fig. 2. Radiograph of a weld in a steel bar, showing welding imperfections

Fig. 3. X-ray photograph of the wax model illustrated above, showing effects of concave and convex edges

A few X-ray photographs out of a large number which illustrate the peculiar effects sometimes obtained, and the commercial applications

Salvaging Fuel from Boiler-Furnace Refuse

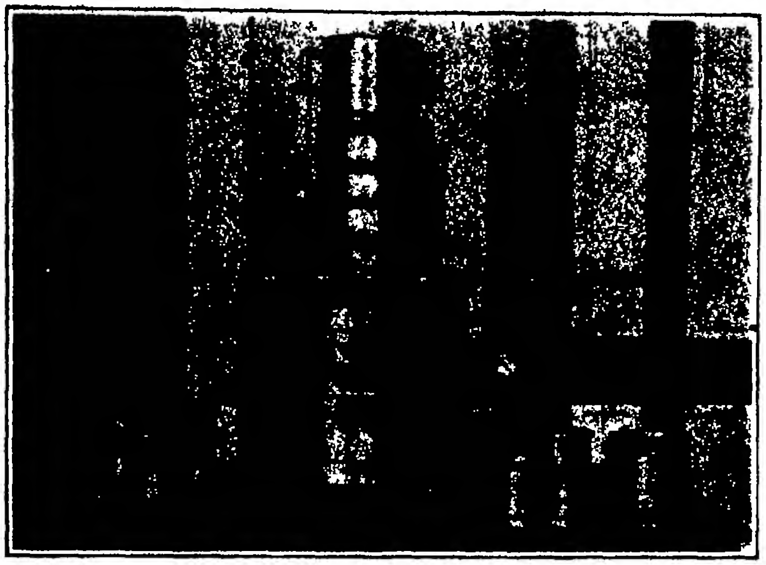
THE development of a process for washing boiler furnace refuse deposited at certain industrial power plants so that one ton of valuable fuel may be recovered from each five tons of refuse is a scientific achievement of which Thomas Fraser and H. F Yancey of the National Bureau of Mines well may be proud in this era of excessive freight rates and costly coal. The importance of this new process is immediately apparent when one stops to consider that over 24 per cent of our total production of bituminous coal is used in industrial power plants. The recovery of unburned fuel from furnace refuse presents interesting possibilities, and unquestionably many of these heavy fuel users will avail themselves of this technical opportunity to recruit their daily coal supplies from their mountainous heaps of refuse. When our domestic freight rates are low and under conditions where the price of coal approaches levels prevalent a decade ago, it is problematical whether it would pay to devote time and energy to fuel salvage of this description. However, with conditions as they are and the cost of recovery only 75 cents a ton, it is practical to rescue stowaway coal from power-plant scrap piles.

In European countries where coal normally commands higher prices than in the United States, considerable experimentation and study have been devoted to the matter of increasing fuel utilization efficiency In Germany a process has been developed for separating unburned coal from refuse by the use of a special, electromagnetic separator In this country the employment of mechanical stokers favors the use of low-priced screenings of high ash content, so that even under circumstances where relatively high percentages of combustible material remain in the refuse, the monetary losses are excessive only under conditions like those now prevalent when freight rates are frenzied and mining expenses unusually steep

The amount of unburned fuel present in boiler-furnace refuse necessarily varies widely in different plants and largely will determine whether or not it will be practical to institute this salvage practice Washing tests made in the laboratories of the mining department of the University of Illinois show the possibilities of recovering unburned fuel by crushing the refuse to pieces not larger than three-eighths inch on coal washing tables, and subsequently removing the slime from the washed product by use of special screens or by means of a dewatering conveyor elevator The coal-washing table used in these tests had a linoleum-covered surface 8 feet wide and 18 feet long supported in a horizontal position with an adjustable traverse inclination. An eccentric head motion at one end gives the table a longitudinal, reciprocating motion of between 235 and 265 strokes per minute. The refuse is deposited at one side of the table by means of a stream of water and due to the juggling motion of the table this waste material is subjected to stratification which results in the deposition of the light material on top and the heavy refuse at the bottom

The light material, which in furnace refuse washing ordinarily consists of coal or coke, is carried over the low side of the table by the flow of water Additional streams of water are supplied by means of a distributing launder The heavy material, which is principally cinder, is prevented from washing down across the sides of the table by means of inclined cleats. The reciprocating motion of the table, which has a slow forward stroke and a quick jerk back toward the head motion end, works the discarded material toward the end of the table, where it drops into a dump place separate from the cleaned fuel discharging from the side of the table.

Experimental tests have demonstrated that the total amount of washed fuel recovered was 20 per cent of the original weight of the refuse treated. Operation of a table washery such as has been developed in these Illinois investigations results in the salvage of one ton of fuel from every five tons of refuse handled. An ordinary one-table unit is adequate for the average power plant which produces approximately 120 tons of refuse every 24 hours as this would admit of the continuous operation of the salvage table. The equipment essential in a simple power plant consists of a corrugated roll crusher to which the refuse is fed directly by a chute from the power plant. The crushed material should be stored temporarily in a feeder hopper from which it may be fed to the washing table by means of a short screw conveyor Two conveyors are used to transport the recovered, washed fuel and the discarded material to their respective storage bins. They also operate to remove the water and fine slime from the fuel.



Set of test weights and measures presented to Fairfax County, Virginia, by George III, and just retired from official use

Dewatering of the washed fuel is essential because a considerable proportion of very fine ash washes over the table with the coke, and the removal of this slime ordinarily will result in a reduction of several per cent in the ash content of the recovered fuel In addition to reclaiming the combustible coal lost in the refuse, this treatment cleans the cinder and makes it more suitable for use as a road material, in concrete mixtures or in other construction work. This treatment also reduces the cinder to a more uniform size, so that it can be conveyed in pipes by steam or water pressure. Operation of a one-unit recovery table of this description would require only a part of the time of one man, as a coal-washing table only requires occasional attention after it is started and properly adjusted. In most cases the freight charges on coal purchased to replace this recoverable, unburned fuel would be more than sufficient to cover the cost of operation, according to the conclusions of Messrs. Fraser and Yancey after comprehensive experiments and investigations.

Coal-washing tables used in the Illinois investigations for recovering unburned fuel from furnace refuse

Electrical Operation of Suction Dredger

A TWENTY-INCH suction dredger in use on the Sumas River in Washington was recently converted from steam to electric operation by a rather simple manipulation As now arranged, the dredger has a total connected load of 1322.5 h p., with motors ranging up to 1000 h p. Current is used at both 2300 and 440 volts, a cable and reel maintaining connection with the shore as the vessel moves forward

Power is taken from the 34,000-volts transmission line that parallels the line of operation of the dredger, leads running from it to a bank of three 500-k v a transformers mounted on a scow moored to the bank of the river This scow and the dredger are connected by a 1000-foot length of submarine cable carried by a reel mounted on a small scow lashed to the dredger This cable is paid out automatically as the dredger moves ahead until all the cable has been reeled out The transformer scow is then cast adrift and moved ahead the slack in the submarine cable is coiled up on the reel, and a new connection is made between the transmission line and the transformer bank in its new position In this way it is a simple matter to run the moving dredge from the fixed power source

The two largest power units on the dredger are the 1000-h p. motor that drives the main pump at the rate of 300 r p.m., and the 150-h p motor that operates the cutter through a set of reduction gears. After the dredger had been in operation for a few weeks, material was being handled at the rate of approximately 600 cubic yards an hour at a cost for power of from 1 to 1¼ cents per yard Under normal operating conditions the dredger requires from 900 to 1000 kw

Relics from an Eighteenth-Century Bureau of Standards

IT was not until the City Council of Alexandria Virginia, decided recently to have a new set of test weights and measures that the story of the measures then in use was revealed It seems that King George of England was informed of the very crude way in which the colonists conducted their trading, and he decided that a more uniform system should be instituted. He therefore had made of bell metal a complete set of testing weights and measures and sent it in 1774 to the King's Council of Virginia. Each piece of the set is inscribed with the words, "Fairfax County 1774," and originally consisted of a set of weights, a set of dry measures, and a set of liquid measures. The weights run from ½ pound to 28 pounds the dry measures from a bushel to ½ peck, the ¼ peck having disappeared in some way, and the liquid measures from a gallon to a gill Of the liquid measures, the ½ gallon the ½ pint and the gill have also disappeared

One of the interesting wet measures is one labeled "wine pottel" According to those who know, this measure was supposed to contain just the amount of liquid refreshment a gentleman of colonial days was supposed to imbibe in the course of a day It holds about a half-gallon, and very peculiarly shows the greatest usage

The measures are huge and cumbersome, the bushel measure alone being about as heavy as anyone would care to lift The sides and bottom of each of the dry measures are about three-quarters of an inch thick and the whole set probably weighs in the neighborhood of 200 pounds. The weights were never intended for actual use in commercial lines, but solely as test measures, and have been so used by the county for 180 years. By reason of the type of metal which was used in their construction they are neither dented nor chipped

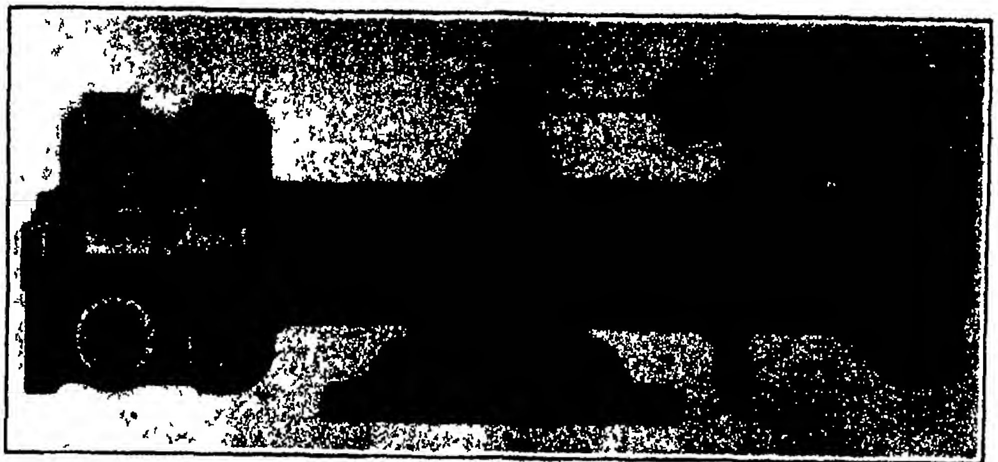
In addition to the weights and liquid and dry measures, there is also a cord-wood measure It is a combination of a yardstick and wood measure, having 36 inches marked off by inches, with an additional elongation of ⅛ inch at either end for the wood measure

The set has been given into the care of the local chapter of the Colonial Dames whose plans call for the permanent care and exhibition of the set in the Town Hall.

Freehand Drawing in the Industrial World

How Engineers Are Being Trained to Use the Unaided Hand to Supplement Drawing Instruments

By R. E. Plimpton


Freehand drawing in charcoal showing steam-driven pump, partly broken away

FOR years engineers—and for that matter architects, too—have used drawings to convey instructions about natural objects. The value of these drawings is limited, however, because the customary method of representing objects, commonly known as orthographic projection, is purely conventional and can be understood only after special training. The method of execution—that is, the use of T square, triangles and instruments—which gives the system the name of mechanical drawing in itself is a hindrance, since it can not be applied for much of the finer work.

It may seem that these limitations are too slight to be worth attention. But anyone who has attempted to puzzle out a complicated mechanical drawing, or to use instruments in drawing arcs of small circles, will appreciate the advantage of simplifying both the system and its method of execution for the benefit of user and maker of the drawings.

As it happens, there is an extremely simple remedy, one that can be learned and used by any ordinary person. This remedy, which is the use of free-hand drawing, is not new, yet its value is rarely if ever realized. The examples accompanying this article indicate the various uses of free-hand drawing in industry. All these drawings were made after only a few months' training in free-hand work. In fact, they were done by students in an eastern technical school, and their remarkable accuracy is due mainly to the course of instruction that has been developed in this school.

Writing is simply the drawing of arbitrary pictures, and there are conventions that can be learned and that apply just as well to the drawing of mechanical things; consequently, anyone who knows how to write can learn how to draw. This belief forms the basis of the instruction given, but its success is due equally to the method of attacking one difficulty at a time and of retaining the interest of the students by the use of actual machinery as models.

The first task is the drawing of spheres, cones, cubes and other geometrical forms. At first these are made of wire, and later solids (wooden) are used. The student is urged to get the main proportions of height to width by the free use of wrist and arm and so to cultivate the judgment of the eye in correctly relating model and drawing. The ability to draw effective outlines then follows, although at this early stage of the training the work in proportions is emphasized, the outlines being held secondary.

The next step is the drawing of combinations of cylinders and cubes, that is, of simple machine parts. Here the student is encouraged to feel that an object farther away looks smaller and must be drawn smaller. In this way perspective is taught, not as a complicated mathematical subject, but as a fact to be recognized in giving realism to the drawing.

As the course progresses the students take up the drawing of light and shade, or shading. Generally this is considered the most difficult part of free-hand drawing, but it proves much simpler and easier—at least for these engineering students—than the work in outline that comes later. The shading gives the objects the appearance of projection or rounding but its main purpose is to help the student judge proportions correctly. At first the shading is crude, but it improves rapidly with practice. The students find this part of the work most fascinating, once they realize its ease of execution. The darkest shadows are put in first, to prove the accuracy of the proportions, and then the half tones, the parts of the shading intermediate between the lights and the darks. Simplicity is sought, and the student works to keep the broad masses of shade distinct, instead of trying to show the large number of minutely varying shades in any object.


Freehand drawing of differential gear, both outline and shading in pencil

The medium used by the students is fitted to their growing ability, just as are the models and the methods of drawing them. The early work is done with charcoal, because it is easy to use, covers space quickly, and can be blended with the fingers for shading. While it seems strange to the students at the start, the feeling soon wears off. A more difficult medium, the pencil, is then taken up, and its firm, clear line used to obtain the almost deadly accuracy required for outline drawings. Finally the students work with the pen, as a training in sureness of touch, or for free-hand tracing.

The training in free-hand drawing is valuable to anyone in industry, executive, engineer, salesman, who needs to put down such things as can not be described in words. The record may be a permanent one, a matter of reference, or it may serve simply as a method for quickly passing on ideas.

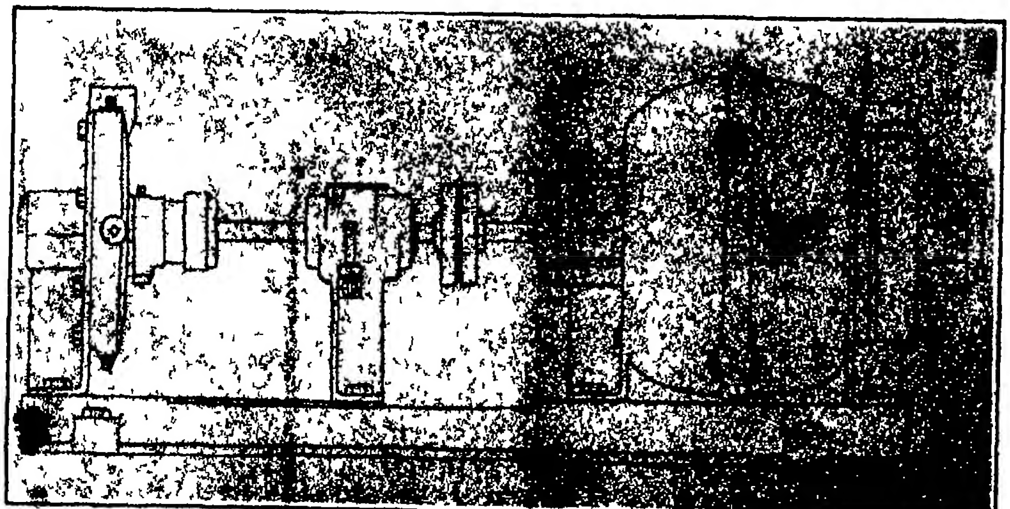
The draftsman is able to draw, without the use of instruments, the arcs of small circles and irregular curves. Or he can use his free-hand ability in drawing pictures of complicated objects, which are almost impossible to understand when orthographic projection is used. These picture drawings are especially valuable for those unaccustomed to the reading of mechanical drawings.

The use of the conventional orthographic methods, the drawing being done free-hand rather than with instruments, offers still another field. Sketches may be quickly and neatly prepared for use by the workmen who make the articles represented, or as preliminary data sheets, giving information to be incorporated later into working drawings.

The draftsman who knows free-hand drawing will be helped in his lettering, which requires good control of the hand to obtain regularity of the strokes, and training of the eye, so that the letters will appear to be spaced uniformly. The importance of this will be realized in every drafting-room, for the title, dimensions and notes of instruction are an essential part of the drawing.

In drawing free-hand the student must study closely the object he draws, and so he learns to know its construction. Here is indicated the final and perhaps the most important use of this training: to develop designers who are that in the sense the term is used in the so-called practical arts. These designers will be a combination of craftsmen and creators—men who can carry out their designs in the materials they intend to use, and who therefore can portray proportions, lines and surfaces to represent an object exactly as it is conceived in their minds. Not only this, but they are successful in making their minds, through the drawings, completely clear to their audience.

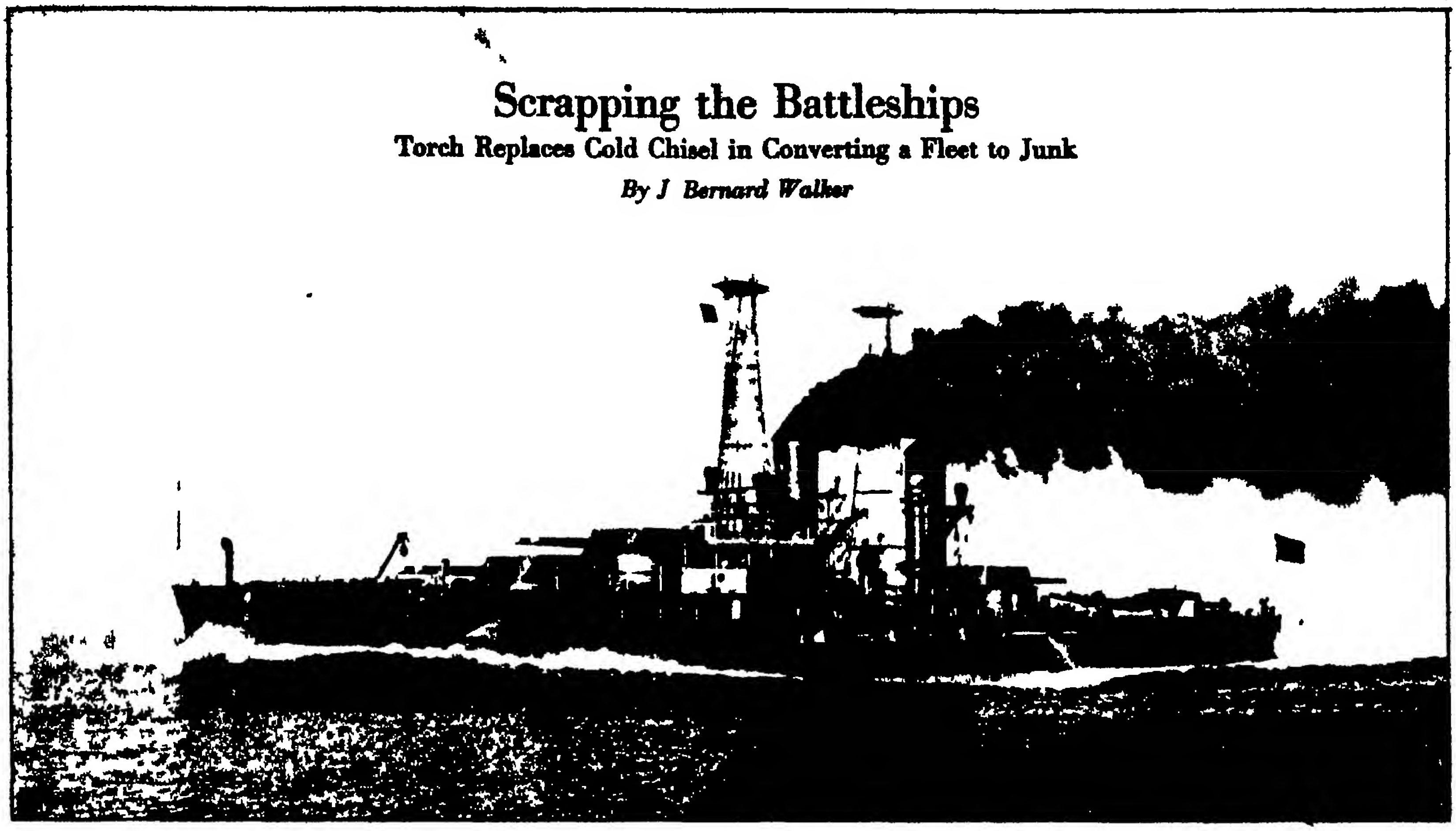
The accompanying drawings have been materially reduced and the half-tone screen is responsible for a considerable loss of fine detail found in the large originals.


Elevation of motor-driven rotary pump, a close freehand approximation to the more usual type of mechanical drawing

Scrapping the Battleships

Torch Replaces Cold Chisel in Converting a Fleet to Junk

By J Bernard Walker

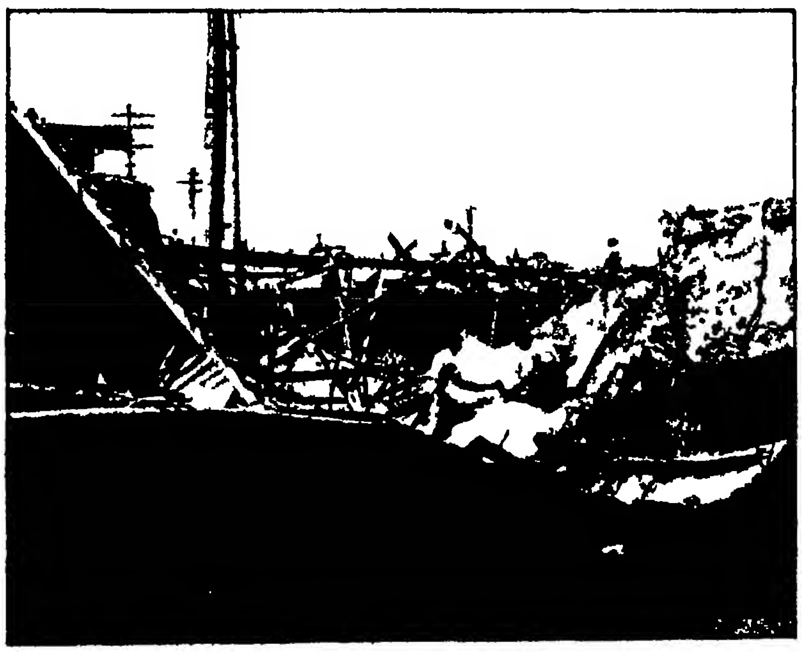


"North Dakota" and sister ship "Delaware", two completed dreadnoughts which are to be scrapped

SO far as the United States is concerned the decision at the Disarmament Conference to break up nearly two million tons of the warships of the three principal naval powers has brought this country face to face with a task for the execution of which it is absolutely without experience The United States Navy is called upon to scrap over eight hundred thousand displacement tons of ships that have been built or are under construction If we reckon into the total the completed ships, and the percentage of completion of the ships that are building the total scrapping operation involves in capital ships, over four hundred thousand displacement tons When this amount has been turned into marketable junk in the shape of steel and brass scrap it will represent three hundred thousand tons of steel and about four thousand tons of brass.

Not only is this a scrapping job of enormous and altogether unprecedented dimensions but for this nation, at least, it is complicated by the fact that there is no one among us, either inside the navy or outside who has ever scrapped a battleship or has any expert knowledge of how the thing should be done The simplest method of disposal of course would be to tow the ships out into deep water and sink the whole fleet but inasmuch as the ships when broken up will represent at market prices for scrap a total sum of several million dollars sinking the ships should be resorted to only in the event that the professional junk firms, and others who put in bids for the vessels should get together and endeavor to beat down Uncle Sam to a point at which he would get practically nothing for the ships and the ship breakers would gather in a very handsome fortune.

Ship breaking, particularly when it comes to breaking up a battleship is an expert job. There are firms in Great Britain, Germany and Italy that have had much experience in this kind of work Two or three British firms have several break up yards located at different centers around the British coast The Germans, because of the task imposed upon them by the Allies of destroying ships, guns and fortifications have also acquired considerable data, knowledge and skill in this work They are also breaking up ships for the British In Italy (at Genoa if we remember rightly) is a firm of shipbreakers which has had long experience in turning merchant vessels into junk Although there are several American firms whose scrapping operations are on a large scale notably the firm which formed the subject of an article in the SCIENTIFIC AMERICAN of July 9 1921 entitled A Giant Junk Yard ship breaking has never figured very largely if at all in their operations The late J Pierpont Morgan once remarked that you cannot unscramble eggs, but the task of breaking up a battleship is literally one of unscrambling Just as the huge fabric was put together laboriously frame by frame plate by plate with all the main elements—protective deck massive side barbette and turret armor—assembled and wrought into accurate position in the ship so commencing with masts smokestacks boat cranes and superstructure the ship must be pulled apart piece by piece and almost in the exact reverse order in which it was put together



Cutting up deck of "Maine" wreck Havana, with sledge and chisel

The old method of scrapping

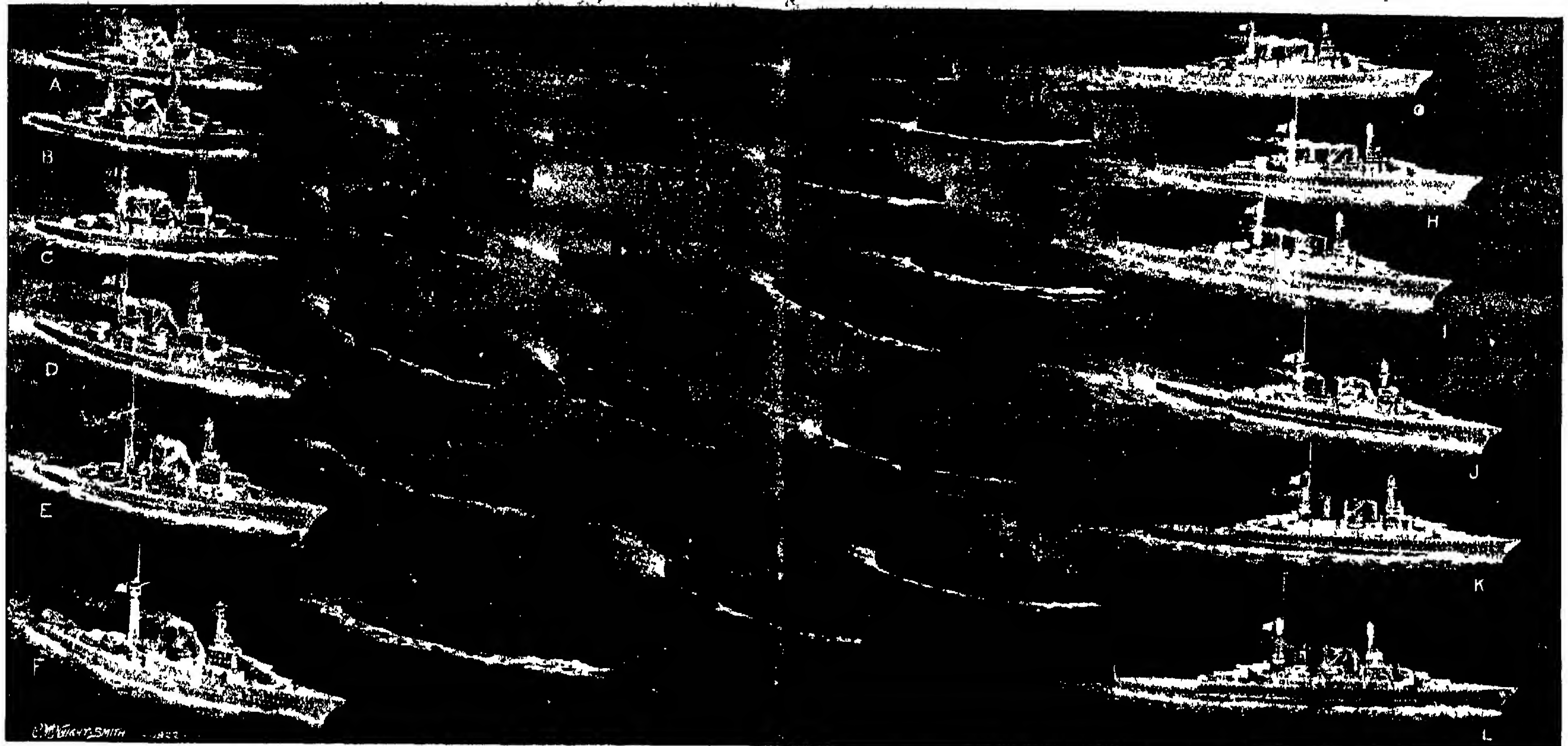
At the suggestion and with the assistance of the Navy Department we are publishing the present article for the purpose of making prospective bidders for these ships broadly familiar with the problem Thus on page 188 we present a hold plan an inboard profile, and a cross section of the battleship Connecticut' These three drawings are based upon the original constructor's plans from which the ship was built They serve to show the elaborate transverse and longitudinal bulkheading of a predreadnought battleship Its extent may be judged from the fact that below the protective deck alone the hull contains over five hundred separate watertight compartments. The space above the protective deck is also freely compartmented, and all of the bulkheads shown in our sketch are of steel The transverse section taken at one of the 12 inch gun turrets, shows the position and thickness of the heavy armor including the waterline belt, the upper side armor the protective deck, the circular barbette and the turret

These drawings are fairly representative of the construction of the fifteen predreadnought ships that are to be broken up Limitations of space prevent our showing any plans of the dreadnought ships of over 43 000 tons, such as the Indiana and the Constitution which are only partially completed It is sufficient to say that they differ from the Connecticut chiefly in the elaboration of the subdivision below the protective deck and in a more effective distribution of the deck armor When the ship-breakers come to tackle these later ships, they will find that all of them consist of what are practically four or five distinct hulls, one within the other with a space of several feet laterally between the shells, or longitudinal bulkheads, as they are called

For an understanding of just what kind of material and how much is worked into a battleship the reader is referred to the tables at the end of this article The first of these is an analysis of the weight of materials actually built into the U S S Maine with the non steel material such as joiner work armor backing and paint listed separately From this we find that in this vessel as offered to the ship

breaker, there are 9772 tons of steel and iron and about 183 tons of brass. The estimate of brass is based upon certain percentages given to the writer by the naval constructors, but although it is founded upon their intimate knowledge of the ship's structure, the total as arrived at is necessarily only approximate. The weight of steel is taken from the original estimate of weights made by the corps of specialists, who compute the weight of a ship at the time when the plans are drawn. This estimate is very close to the exact weight of the "Maine" as offered for sale.

In table No. 2 are given the principal data of the seventeen completed battleships, including the displacement, armament, armor, propelling machinery, and in the last two columns the steel and brass scrap recoverable from the ships. As the time was not available to estimate these weights for each individual vessel in the list, the ratio of steel in the "Maine" to her displacement (or 9772 tons to 12,500 tons) was applied, with modifications, to arrive at the desired figures. Thus, it is found from the official table of weights that there is actually in the "Maine" 9772 tons of steel, which is 78 per cent of the displacement. For the larger ships, such as the 15,000-ton "New Jersey," 16,000-ton "Connecticut," and 20,000-ton "Delaware," the percentage was reduced in agreement with the fact that the larger the ship in any particular type the smaller becomes the percentage of steel. Thus, the 78 per cent ratio for the "Maine" falls to 76 per cent in the "New Jersey" class, and 75 per cent in the "Connecticut." Because of the elaborate underwater subdivision and unusually heavy armor protection of the "Indiana" and "Constellation," the percentage of steel rises again and reaches about 82 per cent in these classes.



The above fleet, if completed, would aggregate 819,800 tons of displacement. The completed ships, shaded dark, comprise 267,800 displacement tons. The uncompleted ships, shown in phantom tint, aggregate 552,000 displacement tons. Of these ships, the West Virginia (6) is 70 per cent completed. The other 12 are from 3.8 per cent to 38 per cent complete. Reduced to scrap, this great fleet represents about 300,000 tons of steel and 4000 tons of brass. The completed ships are (1) "New Jersey," (2) "Virginia," (3) "Georgia," (4) "Nebraska," (5) "Rhode Island," (7) "Kentucky," (8) "Maine," (9) "South Carolina," (10) "Michigan," (11) "North Dakota," (12) "Kansas," (13) "Vermont," (14) "Minnesota," (15) "New Hampshire," (16) "Louisiana," (17) "Connecticut," (18) "Delaware." The ships only partially completed are: (6) "West Virginia," (A) "Indiana," (B) "Massachusetts," (C) "Montana," (D) "North Carolina," (E) "Iowa," (F) "South Dakota," (G) "Constellation," (H) "Constitution," (I) "Lexington," (J) "Ranger," (K) "Saratoga," (L) "United States."

Capital ships that are to be converted into scrap

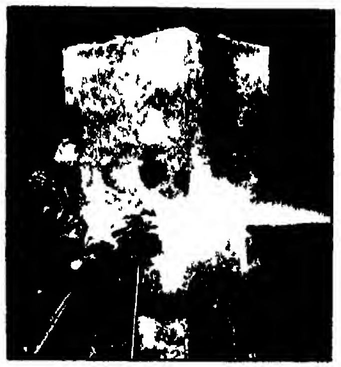
The results, as shown in the last two columns of this table, are sufficiently accurate to serve the purpose for which this article is written, namely, to act as a general guide to prospective bidders. It should be emphasized, however, that while the weights and the items are accurate as regards the ship at the time of her construction and going into commission, certain changes and additions have been made to the ship during her life, which, while they do not affect the structure as a whole, should still be borne in mind in connection with these estimates. The table is drawn up with the expectation that the bidders will personally inspect the ships and gain such additional information respecting them as may be obtained with the assistance of the staff at the various navy yards where the ships are to be found, and from personal inspection of the vessels themselves.

The weights shown in the third of our tables are obtained by first deducing the amount of steel that would have been in the ships had they been completed, and then applying to these weights as found the percentage of completion figures, given in the third column of the table.

But because of the backward condition of these ships, none of which has been launched, the heavier weights, such as armor, guns and motive power, totalling 38 per cent of the whole, have not been installed or only partially so. Hence a further reduction was necessary in the calculation. The weights as arrived at for these ships of the "Indiana" and "Constellation" class are sufficiently exact to enable an intelligent bid to be made after an inspection of the vessels at the shipyards.

With regard to the fourth column of this table showing the amount of brass scrap in the ship, it will be noted that only in the case of the West Virginia, which is 70 per cent completed, is any figure given. This is due to the fact that in the uncompleted ships the work has not been carried to the stage at which any considerable amount of brass or copper has been installed.

The market price of scrap steel and brass fluctuates considerably, but at $12.50 per ton, the steel in the battleship "Maine" would be worth $122,150, and the brass at, say, $200.00 per ton, would be worth $36,600, a total for brass and steel of $158,750. The whole 300,000 tons of steel and 4000 tons of brass scrap in the fleet of ships would have an aggregate value, at the same prices, of $4,550,000. In estimating these values no allowance has been made for transportation, the cost of which will vary according to the distance of the break-up yard from the steel mills or brass foundries.



Cutting through an ingot head, 44 inches thick, with the torch

Acetylene Torch versus Cold Chisel

Three hundred thousand tons of steel scrap cut to suitable dimensions and delivered to the scrap pile at the steel mills, and four thousand tons of brass delivered to the brass foundry, represent, at the current prices for such materials, a very handsome sum of money. But between steel as riveted securely into the fabricated battleship and the same steel reduced to merchantable scrap there is a very wide gap, and the question of profits is very largely a question of labor. The amount of labor employed in breaking up a ship will depend upon whether the breaking up is done by hand labor or by improved mechanical methods, and above all upon the forethought and executive and organizing ability of the man who bosses the job.

Twenty years ago, or even less, the breaking up of a battleship, or any kind of ship for that matter, was a slow and tedious job, and the labor costs formed the greater part of the expense. The only tools available were the sledge and the cold chisel. Before the steel plates could be separated from the deck or shell of a ship, every rivet had to be cut off with the chisel, and this was slow work and costly. The historical picture of the raising of the "Maine" in Havana Harbor, which is shown on page 185, represents two men at work cutting up the deck plating of the wreck of the "Maine," after the ship had been surrounded by a cofferdam and the water pumped out. Today, thanks to that wonderful device, the oxy-acetylene torch, the expense in time and labor of ship breaking has been greatly reduced and the job simplified. The place of the two men with sledge and chisel is taken by a single man using the torch. As shown in illustration, page, 188, the operator directs the white-hot flame against the head of the rivet, quickly reducing or melting it off to the point where a single blow of the hammer drives the shank of the rivet clear.

But the burning off of rivet heads is but a small part of the varied uses to which the torch can be applied. Increase the size of the nozzle, raise the pressure of the gas, and the torch will cut through so many feet of metal with the same certainty with which it cuts through the same number of inches.

The oxy-acetylene torch was used in cutting up 1000 tons of armor at Sandy Hook proving ground

Cutting Up Armor Plate

In the years before the invention of the torch it would have been a puzzling problem to the junk man how to cut up armor plate, ten to eighteen inches thick, into the slab sizes suitable for loading into the charging tray at the steel mills. Today, even the face-cemented glass-hard armor of such a ship as the "Indiana" can be cut into scrap by the ship-breaker. Abroad, many thousands of tons of the heaviest armor have been cut up with the torch, to say nothing of several thousand guns, from the three-inch up to the huge twelve- and fourteen-inch coast defense rifles at Heligoland. Most of this experience has been gained in Great Britain and Germany.

We present illustrations of an interesting contract which has recently been carried out at Sandy Hook, where a well-known acetylene company of Newark and Chicago was awarded a government contract for cutting a thousand tons of armorplate scrap to charging-box size. The plates, three inches thick and measuring about nine feet by thirteen feet, weighed between seven and eight tons each, and were cut into sections measuring thirteen inches by twenty-five inches, each weighing about three hundred pounds. The cost of cutting up the 3-inch plate was as follows:

Rate of cutting, 10 linear feet per hour
Oxygen consumption, 13.25 cu. ft. per linear foot cut
Acetylene consumption, 2.50 cu. ft. per linear foot cut
Total cost per gross ton (2240 lbs.) cut—$7.50

A test of cutting a six-inch plate weighing thirteen tons gave the following figures:

Rate of cutting, 13.8 linear feet per hour
Oxygen consumption, 32 cu. ft. per linear foot cut
Acetylene consumption, 6½ cu. ft. per linear foot cut
Total cost per gross ton (2240 lbs.) cut—$7.00

CUTTING SPEED AND GAS CONSUMPTION OF TORCH

Thickness, inches	Oxygen pressure lbs. per sq. inch	Linear feet per hour by hand	Linear feet per hour by machine	Cub. ft. oxygen consumed per linear ft.	Cub. ft. acetylene per linear ft.
½"	25	55	75	1.05	0.30
1"	35	40	57	2.60	0.65
2"	45	30	46	6.34	0.96
3"	55	24	41	11.3	1.32
6"	85	15	30	24.8	2.70

In regard to the three-inch plate it should be noted that the amount of oxygen used is approximately 20 per cent in excess of that called for in the company's cutting tables, as grouped above. The acetylene consumption was double that ordinarily required to cut commercial steels, which was due in part no doubt to the fact that the work was done out of doors and exposed to the winds which sweep across Sandy Hook. Furthermore, the cutting was slower than for average steel. This was undoubtedly due to the slag which is peculiar to the metallurgical composition of the armor plate, which contained high percentages of nickel and chrome. This kind of steel yields a heavy, viscous slag that does not flow freely from the kerf in blowpipe cutting. The slag not only retards the cutting speed but calls for higher oxygen pressures than are required in cutting ordinary steel of the same thickness.

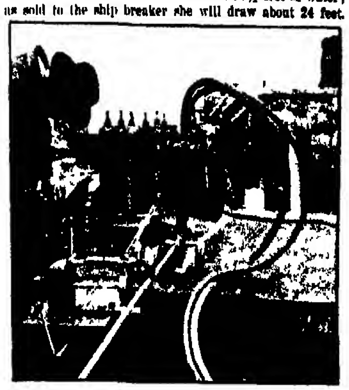
As a guide to estimating the expense of cutting up the steel of which the hull and its fittings are constructed we quote the figures shown in the accompanying table of the speed and gas consumption for metal of various thicknesses as furnished by the company referred to.

For the more rapid and economical cutting up of the armor plate at Sandy Hook the company's engineers developed the machine shown in the accompanying illustration. For motive power, one of the larger sized spring motors, made by one of the phonograph companies, was used. This serves, through friction wheels, to drive a rod which is extended above and across the armor plate, over the chalk line marking the proposed cut. At the farther end of the rod is a little trolley with three-inch wheels, which carries the cutting torch. The usual phonograph speed control is used, and the speed of travel of the torch can be adjusted at will to suit the thickness and quality of the plate which is to be cut. The greater speed of the machine, as compared with hand-cutting, is attributed to its steadiness, as is also its saving in gas consumption. We are told that it makes a clean, straight kerf, which is the economical cut, and it is found that the unskilled cutter can accomplish as much with the machine as the most experienced hand cutter.

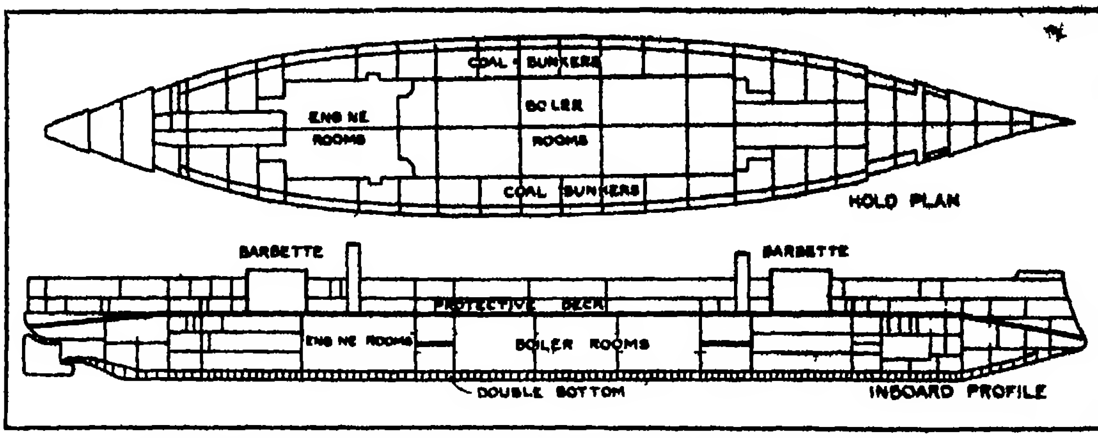
A Suggestion for Ship Breakers

It will not be necessary to do the breaking up at a first-class yard, or incur the renting expense of the largest and most powerful cranes. Any good engineer could design a timber sheerlegs of sufficient height, reach and strength to handle all but a few of the heaviest weights, such as the armor plates, boilers, and engine beds, and it may be found possible to reduce these weights by cutting the masses into two or three parts while they are in place upon the ship. The dismantling and breaking up of the ship will go on, of course, from the top downward. The masts, funnels, boat cranes, etc., can be removed from the ship bodily; the chase of the heavy guns can be cut off in short lengths by means of the torch, and the remaining heavy breech portion would have to be removed by crane or sheerlegs.

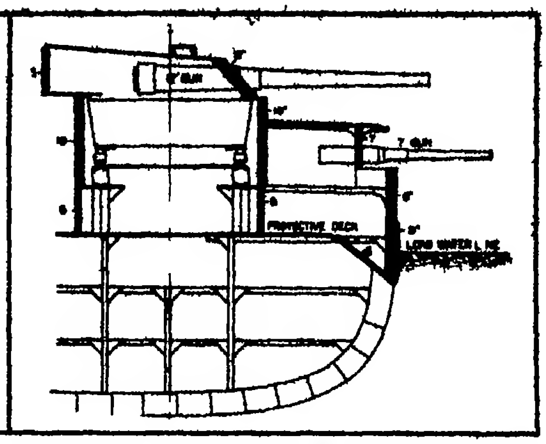
It will be advisable for ship breakers to cut down to the lowest possible limit the time during which the vessel must be in drydock. As the weights are removed she will, of course, come up out of the water. At her normal displacement of 12,500 tons the "Maine" draws 27½ feet of water; as sold to the ship breaker she will draw about 24 feet.



A machine for holding and traversing the torch, designed for cutting the armor plate



Hold plan and inboard profile of Battleship "Connecticut," showing the elaborate system of compartments



Cross-section through the "Connecticut" at one of the 12-inch turrets, showing armor distribution

By the time her armor and guns have been removed she will come up 5½ to 6 feet more making her draft say about 18 feet. As the successive decks, bulkheads, and hull fittings are taken out and the side framing and plating are cut down she will continue to rise. In fact the vessel could be reduced until nothing was left but the double bottom and a foot or two of side plating. Then she would have to go into drydock where the work could be quickly completed.

The Problem of the Armor

The side armor and the heavy armor on the turrets will be the most serious problem in the whole job. The side armor rests upon a shelf and has a backing of from four to six inches of teak worked in between its inner face and the skin of the ship. It is held against the skin by heavy tap-bolts which are threaded into the back of the armor and pass through the skin of the ship and the armor is drawn up snugly against the hull by means of heavy nuts on the tap-bolts also where the edges of the armor abut against each other there are two vertical slots down the full depth of the armor into which square keys of steel are driven tightly. To get these out a heavy eyebolt will have to be tapped into the keys before they can be withdrawn.

Just here a word of warning should be given that it will be inexpedient to use the torch on the outer glass-hard face of the plates. This face for the depth of one to two inches has been heat treated and chilled and the metal is under enormous initial stress. Experience has shown that using the torch on this face is apt to cause the armor to spall off large fragments flying from the face with sufficient energy to break a man's leg. Hence the cutting will have to be done from the inner face and through the main body of the plate which is in a more ductile and tough, and less brittle condition. The safe method would be to remove the plates and place them face down on the ground. We have seen that in the case of a ship like the Maine over 2600 tons out of the 9772 tons of steel in the ship consists of armor. The profits to be made in breaking up such a ship will depend not a little upon the intelligence and skill with which the armor problem is attacked. Furthermore it should be stated that unless the armor is cut into five or more pieces before removal from the ship cranes or sheerlegs of from 30 to 60 tons capacity must be provided to transfer the plates entire.

Burning off rivet heads with the torch

If it were not for the risk to the working crew from flying fragments due to the spalling of the hard face the most convenient way to remove the heavy armor would be to cut it up into vertical strips of slab width while it was still in place upon the ship. These strips would not be of greater weight than could be handled by cranes of ordinary size and after removal they could be cut into slab size as they lay upon the dock. But this would necessitate cutting on the outer hardened face and for the protection of the men it would be necessary to anneal the armor while it was still in place—a job of no little difficulty.

If the armor could be got at on the inner face the risk from spalling would be avoided but to do this it would be necessary to cut through the skin of the ship and remove the wood backing leaving the armor bolts in place until the cutting had been done. This, also would be a task of considerable difficulty. Most of the teak backing however is only four inches in thickness and this could be quickly burned away along the line of the cut leaving the inner face exposed. But if this were attempted means would have to be provided for drawing off the smoke to prevent suffocation. The problem of the wood backing would be encountered on the side armor and on the turrets. There is no backing on the turret roofs, nor is there any on the barbettes or on the protective deck.

In connection with the torch mention should be made of the electric arc which has been used extensively in France since the Armistice in cutting up the steel wreckage of roofs and columns of railway stations and in removing the wrecked bridges. The oxy-acetylene torch is more portable and is, of course in more general use for cutting up work. The arc was employed by the contractors of the East River tunnels of the Pennsylvania Railroad, who used a one-inch carbon rod, bolted to a copper rod. The best results were obtained with 40 volts, 600 amperes, and a ¼ inch to ⅜ inch arc. From 300 to 350 rivet heads could be removed in an 8-hour day. In the same time 4½ feet of 4-inch plate could be burned off. It is necessary for operators to use asbestos masks and aprons and dark colored eye-glasses.

WEIGHT OF MATERIALS U.S.S. "MAINE"

	Tons of 2240 lbs.
Steel hull and fittings	5 170 1
Hull systems—drainage fire fresh water etc	489 0
Propelling machinery engines boilers shafting etc	1 639 6
Wood, including joiner work and wood ceilings	183 4
Armor plate	2 621 9
Guns, main and secondary	623 9
Steel masts ladders torpedo tubes, etc	106 1
Grand total for ship	10 789 0
Included in above total are	
Brass and Copper	183 0
Joiner Work	123 4
Wood Armor Backing Decks Ladders etc	444 2
Cofferdam Packing	44 3
Paint	212 4
Total of Non Steel Weights	1 017 3
Total Steel and Iron in Ship	9 771 6

DETAILS OF SEVENTEEN OLDER BATTLESHIPS TO BE SCRAPPED

	Displacement in Tons	Main Battery	Secondary Battery	Side Armor Inches	Turret and Barbette Armor—Inches	Engines and Boilers*	Steel Scrap in Ship—Tons	Brass Scrap in Ship—Tons
Delaware	20 000	10 12"	14 5"	11 10	12 8	2 T E 14 B&W	14,400	271
North Dakota	20 000	10 12"	14 5"	11 10	12 8	2 Tur 14 B&W	14 000	264
South Carolina	16 000	8 12"	22 3"	11 9	12-8	2 T E 12 B&W	11,840	234
Michigan	16 000	8 12"	22 3"	11 9	12-8	2 T E 12 B&W	11,840	234
Kansas	16 000	4 12"	8 8" 12 7"	9-7	12-10	2 T E 12 B&W	11,840	234
Vermont	16 000	4 12"	8 8" 12 7"	9-7	12-10	2 T E 12 B&W	11 840	234
Minnesota	16 000	4 12"	8 8" 12 7"	9-7	12-10	2 T E 12 B&W	11,840	234
New Hampshire	16 000	4 12"	8 8" 12 7"	9-7	12 10	2 T E 12 B&W	11 840	234
Louisiana	16 000	4 12"	8 8" 12 7"	11 8	12-10	2 T E 12 B&W	11,840	234
Connecticut	16 000	4 12"	8 8" 12 7"	11 8	12 10	2 T E 12 B&W	11,840	234
Virginia	15 000	4 12"	8 8" 12 6"	11 8	12-10	2 T.E. 12 B&W	11,400	215
New Jersey	15 000	4 12"	8 8" 12 6"	11 8	12-10	2 T E 12 B&W	11 400	215
Georgia	15 000	4 12"	8 8" 12 6"	11 8	12 10	2 T E 12 B&W	11,400	215
Nebraska	15 000	4 12"	8 8" 12 6"	11 8	12-10	2 T E 12 B&W	11 400	215
Rhode Island	15 000	4 12"	8 8" 12 6"	11 8	12-10	2 T E 12 B&W	11,400	215
Maine	12 500	4 12"	16 6"	11 7½	12 12	2 T E 12 Thornycroft	9 772	198
Kentucky	11 520	4 13"	4 8" 14 5"	16½	15	2 T E 8 Mosher	9 101	172
Grand Totals of Steel and Brass							190,808	3 810

* T E—Triple Expansion B&W—Babcock & Wilcox

PER CENT COMPLETION AND TOTAL STEEL SCRAP IN THE DREADNOUGHT BATTLESHIPS AND BATTLE CRUISERS

Battleships	Displacement—Tons	% Completion Jan. 1 1922	Steel Scrap in Ship—Tons	Brass Scrap in Ship—Tons
West Virginia	32 600	70	10,517	205
South Dakota	43 200	38	11 163	[illegible]
Indiana	43 200	34.8	10 075	
Montana	43 200	27 6	9 107	
North Carolina	43 200	36.7	10 758	
Iowa	43 200	31 2	9 165	
Massachusetts	43,200	11	3,232	
Battle Cruisers—				
Lexington	43,500	31 1	8 985	
Constellation	43,500	22	5 742	
Saratoga	43 500	32.4	9 008	
Ranger	43,500	3.3	1 990	
Constitution	43,500	12 5	3 674	
United States	43,500	11 5	3,388	
Totals unconstructed ships			109,161	205
Totals, older battleships			190,808	3810
Grand Totals			299,384	4015

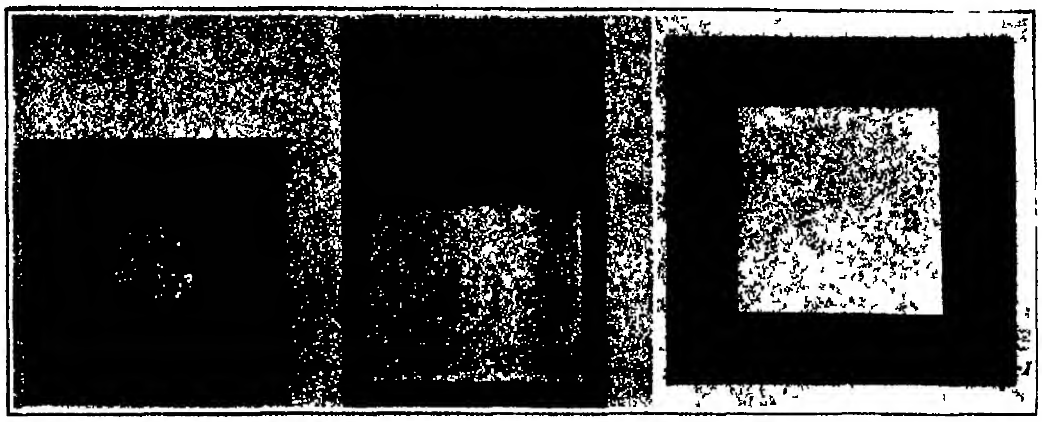
Spectacles for the Motion-Picture Camera

How the Vision of the Lens Is Modified to Produce Fog Scenes and Other Effects

By Charles Alma Byers

"THERE are tricks in all trades," it is said. However true this may be in general, there doubtless are more tricks practiced in the making of motion pictures than in any other one line of endeavor. Many of these have been exposed time and again, but there is one brand of motion-picture tricks about which the public has heard very little, if anything at all.

You have seen, of course, many films in which night scenes have been depicted, and you perhaps have taken it for granted that they were made or photographed at night. Sometimes, it is true, they are photographed at night—by the aid, of course, of strong artificial light, but not always. Many of them, if not the most of them, are actually taken in the bright sunlight of day "How is it done?" is a very natural question.



Left: Black circular vignette, a graduated yellow filter blending into a half-inch clear center *Center:* A cloud filter the upper half, of yellow, graduated to blend into clear glass. *Right:* The fog filter that gives realistic fog scenes, as well as soft-focus, silvery-gray art effects

Some of the things that the cinema oculist prescribes for the camera's eye

You have also seen, no doubt, various fog scenes—pictures in which the screen characters apparently have actually played their rôles in a dense, almost impenetrable fog. To presume that the director has watched and waited for a real fog of suitable density to photograph these scenes is quite natural Yet he rarely or never does that The fog effect instead is usually faked. The director's camera man, by a simple trick of the trade, can, in fact, make a better "fog" picture under ordinary weather conditions than when real fogginess prevails.

By way of emphasizing this it is told of a certain director that he was one evening in the midst of the making of a series of "fog" scenes by artificial means, near Los Angeles, when a very heavy fog began rolling in from off the ocean Presuming the real fog would render the faking of a fog effect unnecessary, he directed his camera man to proceed to a utilization of the real thing, and several hundred feet of film were so exposed. When, however, the film was subsequently developed it was discovered that the faked fog portion came out in lifelike realness, whereas the footage made during the actual fog showed very little of the desired effect. The trouble with the latter was that the fog was in evidence only in the "long-shots" or in the distant background, and not at all in the "close-up" or foreground part of the scenes, while in the faked fog portion the fog evidenced complete envelopment.

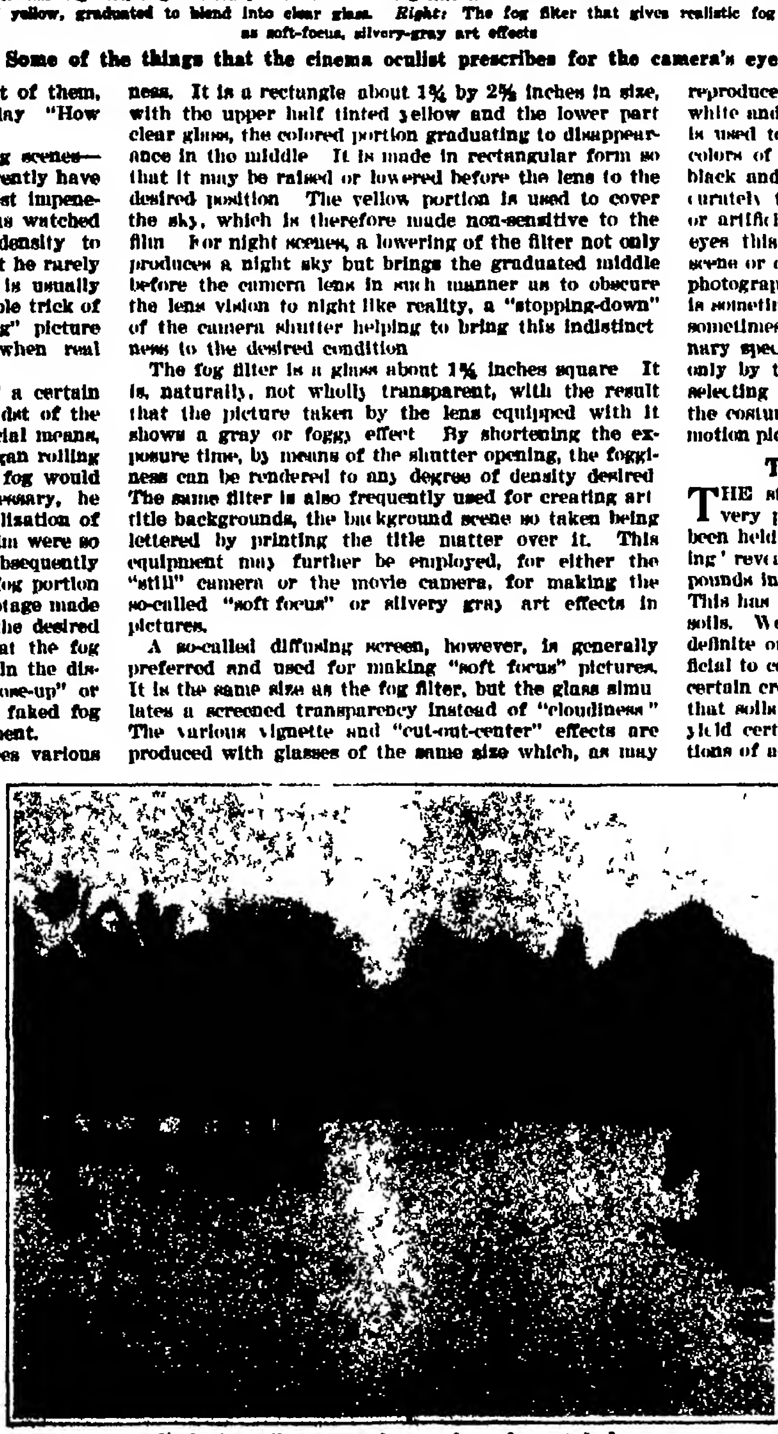
Again, the motion-picture patron often sees various vignette effects in the screen-projected picture, also various close-up views in "cut-out" effect, technically known as "iris" and "irinette" effects. Perhaps he or she may have given but little thought to these, in so far as having curiosity aroused. Nevertheless such portions of the picture—variously revealing close-up views, of reduced size, in fading-edged circles, clean-cut circles and ovals, radiant-edged circles, ovals, hearts, diamonds, panels, and so forth—such portions of the picture are produced, instead of in the projecting as perhaps is generally supposed, by a very simple method of "influencing" the vision of the movie-camera eye, the lens.

The explanation of all this, simply stated, is that the motion-picture camera, when such pictures are being made, wears spectacles. The lens, in other words, is equipped with or supplemented by various kinds of glasses, known technically as "screens," "filters," and so forth.

In the first place, the small square or rectangle of glass, whether called screen, filter, iris or what not, is placed directly in front of the camera lens, where it is held in position by a special, easily attached or detached, holder. The glass or filter used for effecting night scenes is also used for producing artificial cloudiness. It is a rectangle about 1¾ by 2⅝ inches in size, with the upper half tinted yellow and the lower part clear glass, the colored portion graduating to disappearance in the middle It is made in rectangular form so that it may be raised or lowered before the lens to the desired position The yellow portion is used to cover the sky, which is therefore made non-sensitive to the film For night scenes, a lowering of the filter not only produces a night sky but brings the graduated middle before the camera lens in such manner as to obscure the lens vision to night like reality, a "stopping-down" of the camera shutter helping to bring this indistinctness to the desired condition

The fog filter is a glass about 1⅝ inches square It is, naturally, not wholly transparent, with the result that the picture taken by the lens equipped with it shows a gray or foggy effect By shortening the exposure time, by means of the shutter opening, the fogginess can be rendered to any degree of density desired The same filter is also frequently used for creating art title backgrounds, the background scene so taken being lettered by printing the title matter over it. This equipment may further be employed, for either the "still" camera or the movie camera, for making the so-called "soft focus" or silvery gray art effects in pictures.

A so-called diffusing screen, however, is generally preferred and used for making "soft focus" pictures. It is the same size as the fog filter, but the glass simulates a screened transparency instead of "cloudiness" The various vignette and "cut-out-center" effects are produced with glasses of the same size which, as may be readily imagined, are appropriately provided with opaque borders and transparent centers.



A realistic fog effect, staged on a day of crystal clearness

There remains to be mentioned one more somewhat similar glass, the monotone filter This filter is not intended for use as an auxiliary of the camera lens, but is designed for the use of the camera man or photographer to reveal to him just how a certain object will show up in the finished picture When one looks, for instance, at a bit of natural landscape a furnished room or any other scene or object through a camera's ground glass one naturally sees every color and color shade therein represented. The lens of the camera, however, reproduces only in lights and shadows, or in black and white and varying shades of gray The monotone filter is used to inform the photographer just how the real colors of a scene or object are going to reproduce in black and white and also further to enable him accurately to judge the value of light whether natural or artificial In other words, by holding it before his eyes this glass enables the photographer to see the scene or object exactly as it will appear in the finished photograph This so-called monotone filter, incidentally is sometimes rendered into a plain rectangle or square, sometimes into a monocle and occasionally into ordinary spectacle style It is used, it may be added, not only by the camera man, but also by the director in selecting furniture or other paraphernalia, including the costumes of the actors, which is to be used in the motion picture "set"

The Organic Chemistry of Soils

THE study of some notably infertile soils and of very productive soils of the same type which had been held under what we call "better systems of farming" revealed the presence of certain toxic organic compounds in the one which were not present in the other This has led to a study of the organic chemistry of the soils. We succeeded in separating from soils some 35 definite organic compounds, some of which were beneficial to certain crops and some of which were toxic to certain crops and nontoxic to others. It was also found that soils under a certain condition of aeration would yield certain organic products and under other conditions of aeration other organic products. It was found that the compounds separated from the soil were of the same nature as the compounds in the digestive system and in the blood of man and animal, and it was finally realized that the soil has a digestive system, as it were, and breaks down organic materials such as the proteins, carbohydrates, and fats much as they are broken down in the digestive system of animals. The soil has the same kind of bacterial, enzymatic and oxidation processes as are common to the animals. It is evident that soil through these digestive agencies will take care of the excreta of plants and the organic matter that accumulates in the soil from various causes, reducing the organic matter to lower and lower forms of oxygenated bodies until they approach the hydrocarbon type of compounds in our humus, which are stable, innocuous and form the sewage disposal of the soil

In the animal under abnormal functional conditions the too great accumulation of products of metabolism causes a fatigue of the muscles or if the system can not eliminate them the death of the animal Under abnormal conditions the soil becomes fatigued and the plant is unable to function —Note from article by Dr Milton Whitney, U S. Dept of Agriculture, *Science*, Oct 14, 1921

Revising Street Intersections With the Aid of a Model

ON account of the views obtainable from their slopes some of San Francisco's hillsides are extremely desirable as residence sites. Unfortunately, however, little thought was given to the topography by the surveyors who first laid out the city. One set of streets was run parallel to the meridian and another at right angles thereto. The fact that this gridiron plan would later necessitate grades as steep as 55 per cent on some streets and thereby detract from the value of adjoining property apparently was overlooked until many years later.

To eliminate, at a minimum cost, as many as possible of these excessive grades has been the policy of the city authorities. No standard plan has been adopted, but a separate study is made of each case.

For the purpose of visualizing these improvements for the benefit of the engineers and the property owners, models are made as shown in the accompanying view. These not only help the engineers in studying the problems which would be confronted in actual construction, but enable the property owners to see just how the work will look when completed, which helps the city authorities in getting the consent of the property owners concerned with the improvement.

Our illustration shows the first stages in the construction of these models. Cardboard is used, being bent into shape and marked with the names of the streets intersecting and the grades. If desired a clay model can later be built up on the cardboard base.

One of the cardboard models was used with signal success in the work of coordinating at a common point of intersection the main thoroughfares south and west of Twin Peaks: Junipero Serra Boulevard, Sloat Boulevard, West Portal Avenue, Portola Drive and St. Francis Boulevard. A satisfactory design was worked out for the meeting of these boulevards to prevent congestion of automobile and street car traffic and still give a scheme in harmony with the high-class residential districts developed and planned for the immediate and the distant future.

The plan provided a circular space, suitably parked, within which is the network of tracks and special track work connecting the Twin Peaks tunnel line with the existing Sloat Boulevard, the Junipero Serra Boulevard tracks, and a future rapid transit line down the peninsula. Two purposes aside from esthetic, are served by this circle. The railway crossings will be minimized and automobile drivers will be compelled to slow down to make the sharp curve in absolute safety.

The model which aided the San Francisco city engineer in remodeling the intersection of 17th Street and Roosevelt Way. Many similar problems, arising from San Francisco's extremely heavy grades, have been similarly handled

The Freight-Car Liner

MUCH has been said about the loss due to loading of loose grain in bad box cars, and the railroads have in some cases actually been obliged to enforce a regulation against such loading, requiring the grain to be in sacks. We have shown in the past several devices intended to remedy this situation and make loose box cars tight. We now illustrate one which has the specific indorsement of one of the western railroads, to the extent that owners are allowed to ship, at their own risk, loose grain in a car equipped therewith, the regulation against such shipping being suspended to permit employment of this method of economical shipment.

This "car-liner," as the inventor aptly calls it, is just what the name and the picture indicate. The liner is of army canvas, and covers the sides and bottom of the car. It is in a single piece, so that there is no necessity for sweeping out the last of the grain in unloading, it is taken out with the liner and shaken down. In the most unfavorable cases the liner has been installed in three-quarters of an hour, and unloading is a mere matter of an hour, with another quarter hour added to take out the liner and pack it for return shipment. The liner on its record appears to be a means of great saving to shippers and consignees and of relieving agents from much work and worry. In the view below the liner is shown erected in a loft, from the outside. It makes a perfect envelope for the cargo.

Grain can be loaded in complete indifference to the condition of the car if this liner is used

Cliff Improvements at Folkestone

AN example of the practical utility and artistic possibilities of concrete and reinforced concrete, in a somewhat unusual direction is afforded by some works which have lately been carried out on the undercliff at Folkestone, England, by Mr. A. E. Nicholls, the borough engineer. Among various improvements projected, the first undertaken was a pathway of easy gradient giving much needed access between the Leas and the Undercliff Drive. In order to protect the sandy and friable soil between outcrops of Kentish ragstone on the line of the new path, artificial rocks of concrete have been constructed, the texture and coloring being such that it is almost impossible to distinguish between the natural and artificial formation. The concrete work, continues *The Times Engineering Supplement*, is built up from footings, 20 feet or more in depth at some places, and is monolithic throughout. An interesting feature occurs at a point where two lengths of the path run one over the other, the lower one being carried through a tunnel the walls and roof of which are strongly reinforced. Ample provision has been made for the growth of rock plants and vegetation, and it is expected that the appearance of the work will become even more pleasing than it is at present. This improvement at Folkestone should serve the purpose of encouraging a use of concrete which has been applied in the United States far more extensively than in England.

Drop a Nickel in the Slot, and Ride

RECENT issues of the "Subway Sun" and the "Elevated Express," the news sheets which are posted in the trains of New York's rapid transit system as a means of bringing the company's problems and its activities home to the riders, have informed the people who make daily pilgrimages from Dyckman Street to Park Place or South Ferry that there will be no more necessity for standing in line to buy tickets. The system heretofore has been for the passenger to buy a ticket at the window and walk five or six steps to the platform entrance, where he dropped the ticket in a chopping box and passed through to wait for his train. Selling tickets is rather slow business, especially when a good proportion of the buyers have to have change made for them, and during the rush hours many people miss a train which they would have no trouble in catching if they could pass through the gate without delay.

In the new system, being installed as rapidly as possible, an automatic slot machine stands at the gate, which is a turnstile affair instead of being wide open as in the past. The dropping of a nickel releases the turnstile for a quarter-turn, just enough to let one passenger through. If the prospective passenger hasn't a nickel he must get change at the change booth in the rear. It is believed that far fewer people will have to patronize these than before, since under the old scheme even if one had a nickel one had to stop to exchange it for a ticket. The person who does not care to bother about carrying a supply of tickets can perhaps convince himself more easily of the advisability of having one or more nickels among the contents of his change pocket. The possibility of having two turnstiles in charge of a single platform man is also in favor of the new system.

New York's new slot-machine scheme for paying subway and elevated road fares without the delay of buying a ticket

More Comfort with Less Work

A Survey of the Latest Devices That Tend Toward Placing Country Life on a Par with City Life

MODERN civilization has showered all manner of comforts upon us on the one hand, but on the other it has robbed us of much of that physical endurance and strength and even resistance to sickness enjoyed by former generations. This softness, to fall back on the colloquial, is most marked in city dwellers, who are accustomed to exceptionally warm apartments, hot water on tap, no outdoor tasks and chores, practically no physical effort, little or no walking. So habituated has the present-day city dweller become to all these comforts that he fails to realize his softness until he has essayed the rigors of country life. And it is at this point that we begin our present discussion.

Various causes which need not be repeated here have turned the tide. A few years ago the current of population flowed from the country to the city, because of the industrial opportunities that went begging for lack of help and because of the fascination of metropolitan life. But in the present industrial depression, coupled with the unsatisfactory rent situation, overcrowded dwellings and other recent conditions, the tide has set the other way and we find not only the original native of the country returning to his former haunts, but also a large proportion of heretofore dyed-in-the-wool urban dwellers who have decided to renounce city life — at least for the moment.

A Turn in the Tide

So we have a situation that calls for the remodeling of country life, especially in the suburbs and even in localities within a few hours' ride of the centers of population. The one-time city inhabitants will insist on modern plumbing. They want running water, if there is no water supply system, they will install a pumping outfit and reservoir. They want electric lights—oil lamps are absolutely passé, and if there is no electric light system within ready reach, then they will install an isolated electric light plant. They want hot water; stories of how our fathers and mothers broke the ice on top of the basin of water in order to indulge in their morning ablutions are interesting as relics of a past age, but today we want hot water on tap for washing, shaving and the dishes. They want plenty of heat; there was a time when fireplaces were intended for heating purposes, but today the fireplace is just an added decoration for the living room, and serves as a display stand for a collection of ornaments on its shelf and an assortment of andirons and other utensils on the hearth. Today an efficient heating plant is part and parcel of any country dwelling that has any pretensions to being modern.

The heating of the modern country dwelling falls into three broad classifications. There is the hot-air method, in which cold air, drawn from the outside, is circulated about a heated stove and by its own impulse distributed upward through various large pipes. Then comes the steam plant, in which steam is generated in a boiler and distributed through pipes to radiators placed at the desired points throughout the house. Lastly, there is the hot water system, in which a constant circulation of hot water is maintained through a continuous and closed piping system connected with a boiler.

A Question of Choice

The hot air system has been largely superseded by the steam and hot water systems in the more modern homes, because of its dust and dirt. No matter how careful the operator may be in shaking down the usual hot air installation, the ashes generally get into the hot air ducts and are scattered in the form of fine dust throughout the house. Then the usual hot air furnace is larger than the corresponding steam heat or hot water installation; consequently it involves more physical effort than the more modern types. However, it has certain definite advantages, aside from its low cost. Most important of all is the fact that it can be readily started and regulated. Thus in the late spring and early fall the hot air furnace can be started and operated for a few hours with a few pieces of wood, just to take the chill and dampness out of the house.

The steam type of heating plant is nothing if it is not neat—at least as heating plants go. It is relatively small, compact, and readily attended to. The hot water is, if anything, even better, and seems to be the favorite in the dwellings now being built.

It would be reckless, however, to state that the hot air type is going out of style. Here and there one comes across experienced builders and plumbers who insist that it is still the best system. By way of proof they lay great stress on the ease with which it can be started and controlled, its fool proof properties, and the fact that it draws in fresh air from the outside and thus combines excellent ventilation with heat.

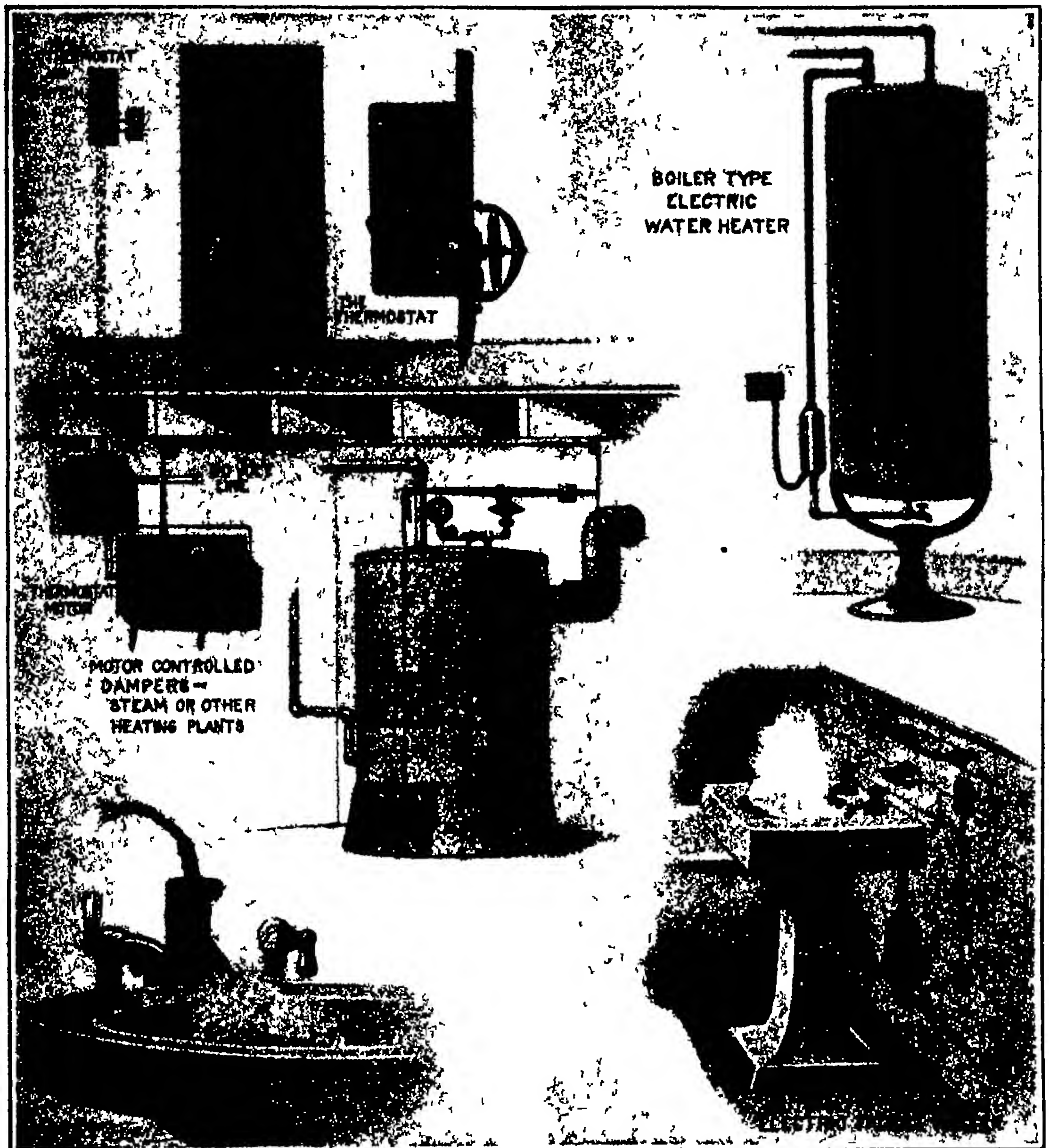
Of late there has appeared the pipeless type of hot air furnace. The design of this type is such that instead of taking in fresh air from outdoors and sending the heated air up through the pipes a circulation of air is created within the house itself. No pipes are used. Only one huge register is employed, through which the heated air passes out and rises to every part of the small house, while the cold, heavier air sinks and passes down through the register to be heated again and circulated through the house. Hence it will be noted that the same air is used over and over again. Obviously, there must be some economy in a scheme of this kind since the air that is used over and over again does not have an opportunity of getting very cold and therefore is more readily heated to the desired degree, in marked contradistinction with the usual hot air furnace which takes in cold air from out doors. Excellent results are said to be obtained in small homes, where a circulation of air is readily effected.

However after all is said and done the question of heating plant is largely one of choice, and also of specific conditions. What proves excellent for one kind of house may prove inadequate in another. The human element, too, counts for a good deal.

From Heavy Coal to Dusty Ashes

No matter what heating system is employed, coal is generally used. Coal has many excellent points in its favor. It is readily obtained in almost all localities, for its distribution is virtually nation-wide—at least where there is a genuine demand for coal. It burns well and requires a minimum of feeding as compared with wood. But the one great drawback about coal is the ash which it leaves under the firebox. The ashes must be disposed of, and herein is one of the meanest tasks to be found about the small home.

On the average one can count on a barrel of ashes every two weeks. Formerly the heating plant had no provision whatsoever for the accumulation of ashes, and one was compelled to take the ashes out from under the firebox and either take them out of the way then and there or pile them up in a corner of the cellar or



The greater part of this drawing is taken up by the thermostatic control for the usual household heating plant. The thermostat, placed in any room, can be set for any desired temperature, and the heating plant is automatically regulated for that temperature. The other views show various types of instantaneous automatic reservoir and boiler types of hot-water heaters

A few of the electrical heating devices which make country life well worth while

store them in a barrel or box. The modern trend, however, is to provide an exceptionally large ash pit under or near the heating plant where ashes over a long period of time can be allowed to accumulate, and their removal can be done in sufficiently large quantity to warrant the effort.

Realizing the work and dirt involved in burning coal, there have been not a few efforts of late to introduce fuel oil for home heating plants. The idea is by no means new, true, but it has taken years of study and experimentation to develop an oil-burning mechanism that would function with precision and would not clog itself up with a surplus of carbon. Judging from the oil-burning equipments now being offered, it appears as though the problem has at last been satisfactorily solved and that in time coal, with all its dirt and ashes and hard work, must be banished from the American home.

Ordinarily fuel oil is the cleanest, most convenient and most satisfactory form of fuel for heating, now that there is available a simple practical and durable machine which burns it without noise, odor or dirt. The market price of fuel oil up to this time has remained around 5 cents per gallon. But even at 10 cents per gallon, heating with fuel oil will be found a much more desirable proposition and no more costly than the old method of heating with coal.

For instance, one of the smaller sized oil burning machines—capable of heating the average ten room residence—can be turned down so low that its fire will consume not more than one-half gallon of fuel oil per hour. Please realize what this means on a mild winter's day, when the fire is turned low, it would require only about 12 gallons of oil for 24 hours' heating. At 4 cents per gallon this would be less than 50 cents for fuel for heating the home one whole day and one whole night.

On the other hand, when a large hot fire is needed it can be had instantly and as simply as turning on the electric lights. It takes only two or three minutes to light the fire when the boiler is equipped with the oil-burning machine, and the fire is hot as soon as it is lighted. Therefore, the fire can be completely extinguished without any of the previous dread of rebuilding same.

Explanation of how simply one of these oil burning systems does the work is interesting in conjunction with the accompanying photograph, which shows the oil-burning equipment alone.

The Ultimate Home Fuel

The oil is drawn from the supply tank, which is placed under the cellar floor, up through the strainer and through the pump, which is located at the center of the accompanying view. The oil is then forced into the pressure chamber and is kept under pressure by the pump. Oil now passes upward through the revolving needle-valve seat which regulates the quantity of oil to be burned. From this point the oil flows downward to the bottom of the revolving cup of the atomizer, where centrifugal force throws it through the tube of oil, which is held in place by centrifugal force. The oil to be burned therefore has time to be separated from the dirt, water and other substances and all find their logical positions, according to their specific gravities. So efficient is this system of sorting out dirt, water and other foreign substances from the fuel oil that a small sized burner in a home ordinarily need not be cleaned oftener than once in two weeks.

But even with the use of fuel oil the small home occupants are not relieved of the task of attending to the regulation of the fire. Here is where another device comes into use—the thermostatic regulator. The most important requisite and one which should never be overlooked in the heating of any building is the regulation of temperature. A system of heating may be ever so good, but if the regulation is poor the comfort and health of the occupants suffer.

The essential feature of any temperature regulating system is the thermostat itself which must be sensitive enough to operate under very slight changes of temperature, yet rugged enough to stand the service required. There are various kinds of thermostats, but fundamentally they all come down to some mechanism which is effected by the slightest

Oil-burning machine installed in a typical home heating plant. Note the simplicity of installation

changes of temperature in such a way as to make certain electrical connections which in turn cause one or more electric motors to regulate the drafts and damper of the heating equipment. The remarkable part of a thermostatic control is that the temperature can be set for any desired degree, and the thermostat then automatically takes care of the heating system and holds it to that temperature.

The thermostatic control system shown in the accompanying drawing makes use of a temperature-sensitive element, consisting of a double-diaphragm chamber containing a volatile liquid. The front wall transmits its motion to a lever arm, which in turn operates a switching mechanism opening and closing an electric circuit. The electric circuit in turn operates the various members of the heating plant as shown in another sketch.

Hot Water without a Fire

As for hot water, many schemes have been put forth of late. Of course, in the past the usual source of supply for hot water has been the kitchen range, which is provided with a water heater that operates without the expenditure of fuel other than that used for heating and cooking. In the case of homes equipped with gas, ingenious water heaters have been introduced in which a pilot light burns steadily and serves to flash on the large burner, as a faucet in any part of the house is turned on. In this manner hot water is virtually on tap—it only takes a few minutes to obtain it.

In homes without gas, especially in summertime when a coal range can not be operated, the hot water problem is more serious. In this case resort may be had to the several excellent oil-burning water heaters. The trend, however, is distinctly toward electric water heaters, of which several types are shown in the various sketches. One type is fastened right on the faucet and is provided with a switch for controlling the heat. Water is heated the moment it flows through this heater, which consumes only 600 watts, or no more than the usual electric iron. Another type is connected to the usual hot water boiler, and serves to heat 25 or 30 gallons of water which is stored in the boiler, ready for use. This type of heater consumes in the neighborhood of 1200 watts, and is provided with renewable heating units. Still a third type is the automatic-reservoir faucet-heater, which heats a small quantity of water and maintains it at a given temperature, ready for use at any time. The usual capacity of this water heater is five gallons.

All in all, country life is not what it has been. The time is fast coming when the country resident will enjoy the same comforts as the city dweller, with a great many more pleasures as well.

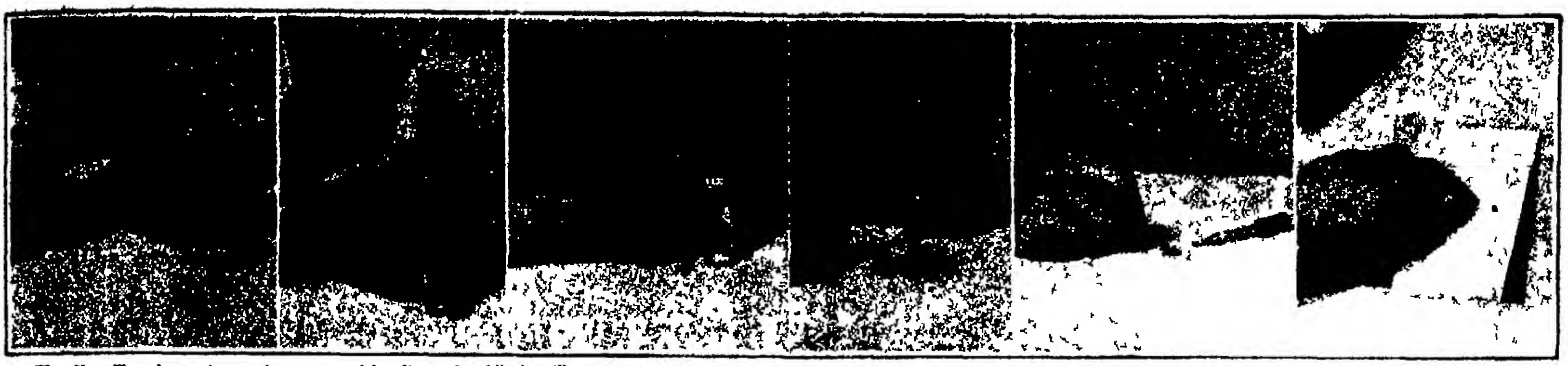
View of the oil-burning machine, showing the motor drive at the left and the burner proper at the right

Failures of Bronze and Iron Bell Clappers

SOME failures of church-bell clappers induced a member of a large German steel foundry to experiment on the behavior of steel rods under conditions similar to those to which a bell tongue would be exposed. He observed that many of the specimens broke, although quite sound near the fracture, in a way for which an adequate explanation had not yet been found. He suspended his rods between two blocks of cast-iron which the rod would strike when deflected 45 degrees to the right or left. The suspension was by means of a leather loop fastened in the first series of tests round screw bolts fitted into the upper forked end of the rod. Most of the rods were club-shaped, thickening toward the bottom. The first rods broke across or near the bolt holes, after 90 hours, corresponding to 185,000 double blows. When the bolts were replaced by cast-on lugs, the fracture occurred after longer service, 220 hours, and lower down, near the point where the rod began to thicken. The material was superior mild steel, an exceptionally good nickel steel lasted longer, but broke, too, finally. Two well known experts both suggested that it would be more advisable to reduce the cross-section in the middle portion of the rod than to increase the section. Long flat rods, not specially weighted at the bottom, were then tried. They lasted 500 hours, but when a small indentation, about 0.5 mm deep, was made nearly halfway down the rod, with the aid of chisel, the rod broke across at that spot on further experimenting. Then a kind of flat bar pendulum was used, oscillating with its greatest section at right angles to the direction of motion, this also lasted more than 500 hours, but then developed a crack on the one side, halfway down. One expert recommended this shape, i.e., a clapper with a long, relatively thin and yielding shaft. One would think the failure would be due to resonance effects. The fractures did not indicate any deformation or flaw of the materials nor any want of homogeneity. The tests are severe, of course.

How the Color of the Ground Affects Plant Growth

SOME curious experiments as to the effect of the color of the soil were recently described in the French journal *La Traction Moderne*. These experiments were made in a vineyard. The surface of the soil was lightly covered with reinforced concrete, a suitable space being left vacant around each vine stock. One-third of this concreted surface was painted white, another third ochre red, and the remainder black, the results were very remarkable, since in those plots which had been painted red and black the vines were twice as vigorous as on the white plots. The reason for this is that the temperature of the ground is considerably higher in those areas having either a red or a black color, and this increase of temperature has an immediate effect upon the growth of the plants. These studies throw light on the superiority of the soil of certain territory, such as the black earth in Morocco. It has been noted, too, that the earth in some of the best grape-bearing localities in the South of France is either reddish or black, and this no longer appears as a mere accident.



1 The file will make an impression upon a false diamond while it will not touch a genuine one 2. The chemist has a simple means of causing a fake diamond to burst, by a process that will not harm the real gem. 3 Hydrofluoric acid will dissolve an imitation but will have no effect upon true diamond. 4 The real diamond will shine with some brilliancy when immersed in clear water the paste article is entirely dull under these conditions. 5. On a true diamond a drop of water will hold its globular shape, much as quicksilver does; on a fraudulent stone it will "spread" 6. A real diamond can be used as one of a pair of lenses, and will give sharp focus; the paste stone will never do this

Six simple tests that will separate the imitation diamond from the genuine stone

To Put a Diamond to the Test

A VARIETY of tests may be advisable for one who is not an expert judge of diamonds, and even one who is, an imitation may leave temporarily puzzled so that some mechanical or physical test is resorted to. The old test of cutting a piece of glass with the stone under investigation is now reversed, though with an additional variation. A file takes the place of glass, and the rasping edge of the little tool is brought against the sparkling surface of the gem under suspicion. This is an attack no impostor can survive for a single instant. No impression, of course, can be made on a genuine diamond.

Another test even more severe consists of the following procedure. The stone is covered with borax, heated and then dropped into a receptacle containing cold water. Glass or similar imitations will be shattered, but a diamond comes through the ordeal unharmed.

Cleopatra may have dissolved her pearls in vinegar so as to make a priceless drink, but the vinegar of that day must have been exceptionally hard on the lining of the stomach if it could perform so astounding a feat. But today your diamond (if it be spurious) can be readily dissolved. Hydrofluoric acid will turn the trick for you. A genuine stone, of course, is immune to this test.

There are two tests with water that are equally interesting in demonstrating whether or not you have been imposed upon by some trickster when you decided that nothing but a diamond would complete your happiness. One of these is simply to drop the stone in a glass of clear water. The stone, if it is a genuine diamond, will still continue to radiate some of its brilliancy, but a "paste" will have practically lost all of its glow and luster.

The second water test consists in putting a drop of water upon the stone's surface and moving it about with the point of a pin. With a diamond the drop will remain globular and hold together after the manner, somewhat, of a particle of "quicksilver." But on glass the drop will spread.

Some of these tests, it will be noted, are purely chemical ones. If directions are followed nature's forces do the rest. Others depend in a measure upon careful use of the fingers, but a final test depends upon the eye solely. Take a sheet of white paper, and upon this make a round black point with a pencil. Then hold the diamond a short distance away from this point with the left hand, while with the right hold a glass and through this get the stone in focus with the pencil dot. If the dot can be seen clearly the stone is a diamond, but if there is a fogginess about this pencil point or if several pencil points appear, the stone is an imitation.

Musical Strings and Where They Come From

THE string choir is often called a "string quartet," but this is not strictly accurate, as we now employ five instruments in this division of the orchestra: first violin (soprano); second violin (mezzo soprano); viola (alto or tenor); violoncello (tenor or baritone), and contra bass (basso). The violin is undoubtedly the "king of the orchestra" and is, in truth, the brilliant prima donna of the wooden stringed instruments, whether for coloratura or dramatic effects. The viola is an older instrument than the violin and is much esteemed. The violoncello is a development of the old "knee fiddle" and the stately double-bass furnished a firm foundation for the lighter sisters of the string choir.

Formerly strings were made of catgut, but in reality

Stretching double bass strings

the modern strings are made from the intestines of sheep or from wire, and may be either plain or covered. Gut strings are used for other instruments which do not belong to the noble family which we have enumerated, such as the banjo or harp where the fingers are used, or where a pick is used, as on the mandolin. Metal strings are used for all instruments which are struck with hammers, mallets, etc. such as pianos, zithers, cymbalums, etc.

Each string in a violin is of a different thickness, according to the tone and tension required. The fourth string is covered with fine wire, either a white metal or real silver, hence it is often called the "silver string." Violas, violoncellos and double-basses have each two covered strings, the object being to insure a sufficient gravity of tone without having too clumsy a material. The covered strings on the guitar are upon a basis of silk instead of catgut. The best gut comes from Italy, which has been famous for centuries for this product. Strings are carefully selected and graded as to size so that they shall be uniform. The larger strings for the bigger instruments are stretched on frames for three or four days as shown. The covered strings are finished on a special lathe which covers them with floss silk or fine silver-plated copper wire, or even silver.

The instruments of the "string choir" are all played with a bow, with occasional pizzicato, or plucking of the strings, as required by the music. A bow is an instrument of wood and horsehair employed to set the strings of the violin or other musical instrument in vibration. As its name implies, it was originally curved. The violin bow is usually about 29 inches long and the stick has a slight curve inward. The violoncello bow is a little shorter. The double-bass bow has a large arch and is shorter. The early bows were so crude that they added little to the delicacy of tone. The earliest improvement was made when a metal band with teeth-like edges was introduced with the design of regulating the position and tension of the hair at or near the handle. It was reserved for Francois Tourte (1747-1835) to devise the plan of keeping the hair flat by means of a clasp and the screw and button for slackening or tightening the hair at pleasure.

The horsehair comes largely from Russia and the upset conditions of the last few years have had their effect on the product, much to the disgust of the musician. South America was looked to for the supply when that from Russia was cut off. It is, however only a question of time when the Russian ranches, where the horses are bred for the purpose, will continue their supply with something like the old time quality. The primary sorting of the hair takes place at the ranch from which it goes to the bleacher, who bleaches the hair with sulfur. It is then bound up in hanks of 100 to 150 hairs, and the hanks are then ready for export. One hank usually goes to a bow. On arrival at the bow factory or the repair room of the large dealer the hair is combed out and fixed on the end with shellac as illustrated. All work of this kind is strictly hand work and a factory in the ordinary sense of the word, with its dozens of men, is unknown to this queer trade; two or three workmen are usually all that are required. The workmen insert the hair in the top end of the stick with a wooden plug. The hair is then straightened out by means of a special comb and fastened into the frog at the lower end of the stick. A professional violinist has to have his bow repaired every two or three months, and the cost is usually one dollar, so nobody will every get rich on this, but if the virtuoso wishes to be reckless he may buy a "G" string covered with gold wire.

Hairing violin bows in a typical musical instrument shop

A New Caterpillar Development

British Efforts to Save Power and Increase Speed by Means of a Track That Will Yield to Local Obstacles

By F. Rowlinson

THE "caterpillar vehicle," as the type of machine which lays its own tracks has been christened, has not made the commercial headway which its many theoretical advantages have led enthusiasts to predict It is true that for agricultural use and in undeveloped countries where transport facilities are non-existent, and also in some cases of locomotive cranes for work on soft ground, the truck laying vehicle has had a fair degree of success. Also during the war the successful development of the tank, both in the heavy armored types and in the lighter whippet vehicles, was certainly dependent upon the caterpillar track But in the early tank designs much trouble was experienced, and many failures, because the knowledge of caterpillar-track design was fragmentary and incomplete These early tank designs were experimental, and from them much important data was evolved to serve as a foundation for later experimental work on peace-time designs. So the development of the tank in its various forms gave a great impetus to the design of track laying machines generally None the less, even the most ardent advocates of caterpillar machines on theoretical considerations confessed themselves disappointed by practical results. For instance, in competitive trials of agricultural tractors in England the caterpillar types evinced no overwhelming superiority over those types employing ordinary wheels.

With the object of overcoming the inherent difficulties of the design of caterpillar vehicles a recently developed type of caterpillar track has been experimented upon by the British Ministry of Transport This new type of vehicle tackles the problem from a novel point of view, and some remarkable results have been obtained

The theoretical advantages of the caterpillar type of machine lie first in its ability to carry heavy weights without imposing upon the ground any great superficial pressure In other words, the weight is (theoretically) spread over a very large *area*, with a wheeled vehicle the support is more of the nature of a *line* support This is the theory In practice it is found that on soft ground the ordinary wheel sinks in until a sufficiently great area is buried When the superficial pressure on the ground is reduced to a degree which the ground will bear sinkage of the wheel ceases But the wheel always has opposed to it an inclined plane as it attempts to climb out of its rut, the inclination of this plane depends upon the depth to which the wheel has sunk (which depends in turn upon the width of the wheel track) and the size of the wheel The remedy is to widen the wheel track as far as practicable and to increase the size of the wheel The caterpillar track as usually built, is equivalent to a very wide wheel with a very large diameter, the lower track performing the same function as a portion of the rim of a wheel perhaps 100 feet or more in diameter For soft ground this theoretical advantage is only realized partially Were the ground perfectly plane and free from local unevenness, then practice would agree with theory But as no ground (at all events, no ground for which caterpillar vehicles are necessary) is free from local obstacles, it frequently happens that a machine designed to distribute its weight evenly over a large area has at a particular moment, as much as half of its total weight concentrated on a very small obstacle The result is to crush the obstacle if it is soft, or to jar the whole machine if it happens to withstand the weight In neither case is the theoretical advantage of the caterpillar track realized For if the obstacle is crushed energy is absorbed in crushing it, and the measure of inefficiency of the track system is found in the crushed smooth rut it leaves behind If no crushing takes place, then the whole mechanism, with its heavy load, is subjected to a violent shock as it passes over the obstacle

The first essential, then, of an efficient caterpillar track is that it shall yield *locally* to small obstacles, the second that such obstacles shall not be called upon to withstand any greater superficial load than the ground under the rest of the track If we examine existing types of tracks as commercially developed it will be found that *local* flexibility of the track is either entirely absent, or else so small as to be negligible in practice We shall see later how this defect has been overcome in the latest experimental vehicles.

One result of the failure of the ordinary type of track to yield to local obstacles is that the multitudinous pins, links and joints which compose the ordinary track have all to be designed to take very great loads and shocks Moreover, the multiplicity of these pins, links and joints is in itself a serious drawback, both in first cost and in maintenance. They can never be efficiently lubricated, from the nature of the work they have to do and the ground they have to cover and at the best it is found that their chief lubricant is liquid mud Consequently their replacement costs loom very large and this in conjunction with the heavy prime cost makes the use of such types of vehicle prohibitive for ordinary commercial operations. We arrive therefore at the third essential of the ideal track, that it should be simple with as few joints, pins or links as possible, and that these should be amply lubricated. From the third desideratum we arrive at the fourth—efficiency The mechanical efficiency of the ordinary caterpillar track is lamentably low. The multiplicity of unlubricated small parts and bearings, together with their comparatively great weight, makes it necessary to provide an engine disproportionately large for the useful load. Further, even with a powerful engine, high speeds are impossible. The ideal track must therefore possess high efficiency at moderate speeds, and also be capable of adaptation to high-speed machines moving over rough ground.

An ordinary passenger car converted to the caterpillar type

The last great defect of the ordinary caterpillar is the awkwardness of the steering arrangements. A track consisting of a great number of linked components can not be deviated for steering. In all ordinary caterpillars steering is effected by a differential gear, one side or the other being partially locked by a brake. The track which runs the faster pivots round the other track, and sideways skidding of the track results. If in order to make a sharp turn one track be completely locked, then the whole machine will pivot round the center of that track, and the length of the track must skid bodily sideways to turn. The ideal track will enable the machine to turn in a reasonably small circle without skidding or awkwardness.

No ideal track has yet been constructed. The experts, however impressed with the idea that unless some developments in the direction of increased efficiency were forthcoming the caterpillar can have little or no commercial future, have evolved a type of track which seems to promise a great step forward toward the ideal

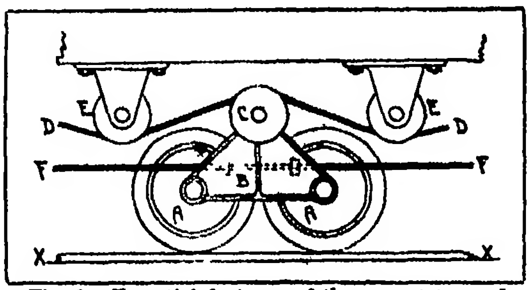


Fig 1 Essential features of the newest type of caterpillar suspension, developed in Great Britain

Fig 1 shows the principle of the new suspension. It will be seen that the wheels AA, which run in contact with the flexible track XX, are pivoted in pairs on triangular bogies B On each bogie are double pulleys C, over which a wire rope DD passes. This wire rope also passes under pulleys EE, attached to the chassis. A second wire rope FF connects together the whole of the bogies B, and the ends of this rope are secured to the vehicle, the rear connection being through a strong spring It will be seen that each unit, consisting of a bogie and two wheels, can float sideways on the rope, and also vertically When the track passes over an obstacle the bogie immediately over the obstacle rises against the tension of the rope, the necessary extra rope for the movement being provided by the compensating spring at its end As the entire weight of the machine is suspended upon this rope in tension, it will be seen that the distribution of pressure is equal over the obstacle and over the rest of the track. It is further obvious that the use of a wire rope obviates the many pins and joints necessary in the usual track, the rope also withstands abrasion by grit much better

As an illustration of the increase in speed and overall efficiency obtained by means of the new caterpillar, an experimental conversion of one of the tank type of machines may be cited. This machine, which weighed 30 tons, had with the original track a maximum speed of 5 miles per hour After the necessary conversions to the track, suspension and gears the speed was increased to 15 miles per hour on the level, and 25 miles per hour on a slight down gradient.

Several experimental types of vehicles have been fitted with the improved track. We illustrate an ordinary chassis converted to the caterpillar type. The track, it will be observed, consists of a stout rubber-covered belt running over large pulleys front and rear, these being the original wheels of the car slightly modified. The way in which the individual elements of the suspension adjust themselves to local obstacles is well shown, and the principle of the suspension is made very clear. The friction-driven rubber belt is very light, and permits the attainment of high speeds. This model has exceeded 30 miles per hour over rough fields. At this speed the shock due to obstacles was completely absorbed by the suspension, and no perceptible jar was transmitted to the passengers. Another interesting experimental vehicle is that where a similar flexible rubber track is applied to a motor scooter. The frame

Another interesting experimental type of crawling drive

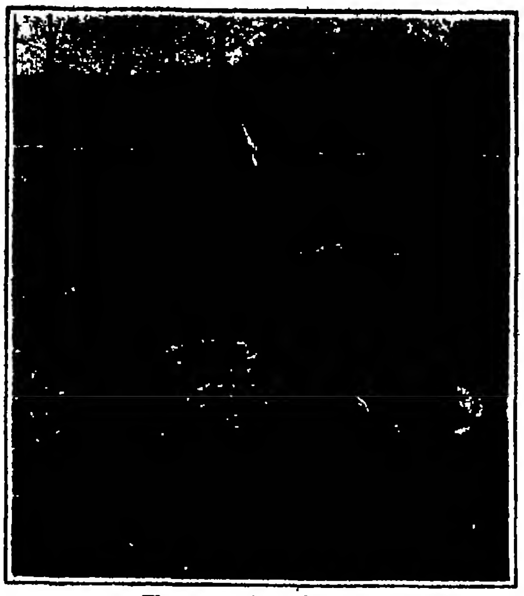
and engine of this are converted from a motor bicycle. With the engine shown, a small 260-c.c. horizontally-opposed twin, this vehicle can maintain 20 miles per hour over rough ground with no discomfort to the rider. It will be noticed in the case both of the car and the scooter that steering is provided for by the lateral play which the flexible rope suspension permits. The scooter is capable of turning, by deflection of the track, in a circle 5 feet in diameter. It must be understood that these models employing the flexible rubber track are not designed for commercial operation. This type of track, although admirably suited to experimental work, is by no means ideal, and the types shown must be regarded strictly as experimental. None the less it would seem as if with the light pressure obtainable by the use of this track and the absence of skidding in steering, these tracks might be developed for use by commercial vehicles where comparatively high speeds over rough country are called for.

An application of the new system to a more conventional design is shown. Here the track is composed of metal plates jointed for experimental purposes in four different ways. The lower front part of the near track in the illustration will be seen to be jointed by flexible ropes between the plates, the upper and rear portion being connected by special link pins, which are protected and lubricated by leather sleeves holding grease sufficient for many hundred miles running. The rear track is composed half of special ball type connections, giving large bearing areas, and half of ordinary chain connectors. No special provision has been made in this machine for steering by deflection of the track, but it can steer in a fairly wide circle by reason of the lateral play afforded by the rope suspension. The model illustrated is carrying a heavy load of army bridge-pontoons, but the distributed load does not anywhere exceed 2 pounds per square inch.

The illustrations show types which are admittedly experimental only, but if these early experiments bear out their promise of closely approaching the ideal they will revolutionise caterpillar design, which is at present stagnant. It is admitted that in undeveloped or partially developed countries there are many transport difficulties which a cheap, rapid and practical caterpillar vehicle would solve. In many instances land lying a few miles inland is inaccessible solely by reason of transport difficulties. Such land is not developed until a railway is built, and a railway will not pay until the land is developed. The ultimate fate of such land is that in the past it has never been developed. A form of tractor enabling sandy deserts, swamps and even steeply-banked rivers to be successfully negotiated at comparatively high speed will aid immensely in the development of such territories.

Constructional work in rough country is always impeded by the difficulty of access. Even where power excavators have been used to clear the way for railways, etc., in many instances the ground has not proved satisfactory for these. The caterpillar track has certainly been adapted for use by the constructional engineer, and excavators, cranes, etc., have been fitted. But the high maintenance costs, the low over-all efficiency, and the low speed have all militated against their extensive use. The recent developments described in this article seem to open up a new field in constructional engineering.

It is not only over rough or difficult ground that the new suspension system promises to make good. The conditions of modern road transport call for high speed combined with heavy loads. The consequence is that the roads are pounded into transverse waves, and that vehicles are subjected to severe shocks which shorten their life. For it must be remembered that not only does the vehicle pound the road but the road also pounds the vehicle! To a certain extent new methods of road construction on the one hand, and the increasing use of giant pneumatics on the other, are helping to defeat the effects of shock on road and vehicle alike. None the less if a suspension can be developed which gives an approximation of a truly "giant" pneumatic of over 200 feet in diameter, with a high over-all efficiency, then we may expect to see caterpillar tractors in use not only for rough country and soft ground but at high speeds on ordinary roads. The caterpillar is as yet in its infancy.



The caterpillar "scooter"

Close-up of the 3-ton artillery tractor

Electric Burglary Alarms

THESE were hardly known a few years back, but today there are a great many of the most varied kinds in use. Generally they are designed so as to sound the alarm as soon as a door or window is moved or receives a shock. Movements of the whole building such as are caused by the passing of a heavy vehicle in the street must, of course, not set the alarm going. A suitable device should be constructed so as to sound the alarm also when it is being switched off and when the wires are being bridged over or cut. In one burglary alarm a small ball is caused to drop into a bearing and complete the circuit at the slightest movement or shock, setting a buzzing alarm going. Another device consists of a hollow and hinged arm that is put across the door to be guarded of a night and put back during the day. From the arm a small peg projects that may slightly touch the door of, for instance, a safe. In the hollow arm there are two balanced levers to which the shock or movement is transmitted and these set the alarm going. The apparatus of another company is constructed so as to notify the police at once automatically over the telephone as soon as a stranger enters the closed house or flat. Sometimes it is not sufficient to guard just a door. There may be danger of burglars entering through the ceiling or walls. For such cases a so-called listening plant is installed, which consists of a number of microphones that are fixed in various parts of the premises.

Caterpillar Ordnance

THE United States Army is working toward the elimination of the horse and as a consequence three new types of motor equipment have recently appeared sponsored by the Ordnance Department. These are a three-ton artillery tractor of unusual ability, a tractor mounting a 75-millimeter gun, and an eight-wheeled tractor carrying a 155-millimeter gun. At the present time only the 75-millimeter vehicle is waterproof so that it can ford streams, but later on it is intended that all machines shall have this ability.

The three-ton artillery tractor was designed to take the place of the six-horse artillery team for hauling light artillery at speeds corresponding to the gallop of a horse. It has an unusual spring suspension and is particularly well adapted to ride through sand, marsh and rough country without slackening speed.

The creeper belts are so sprung that they will follow the contour of uneven ground in much the same fashion that a snake does it. The lower side of the belt is forced into contact with the ground through the agency of four rollers, each pair of which are connected to one end of a cantilever spring. These springs are pivoted to the frame. Their other ends are linked to four rollers bearing against the upper side of the belt. This construction causes the lower side of the belt to follow the contour of the ground and at the same time keeps the belt taut regardless of the contour. It is interesting to compare this with the rope suspension described above by Mr. Rowlinson for gaining the same end.

The problem of building a satisfactory self-propelled gun mount seems to have been pretty well solved by the type illustrated which was developed by the Ordnance Department. One of the most serious difficulties has been that of keeping the weight down to a point where road bridges would carry the load. Another is the problem of wheel drive for roads and creeper drive for cross-country. Considering that the gun has a bore of somewhat more than five inches it is remarkable that the total weight of the vehicle is only 22 tons, the gun itself 6 tons.

It is propelled by a 120-horsepower six-cylinder engine driving through a four speed gearset. Wheels are driven through internal gears. When the truck is removed the middle wheels are drawn up out of the way by a hand crank arrangement.

Left: Eight-wheeled caterpillar mount carrying 155-millimeter gun. *Right:* The 3-ton artillery tractor in action

The sort of service that is demanded of crawling gun mounts and gun tractors

Duraluminum

The Properties and Commercial Possibilities of This New Alloy

By William B. Stout

THE mere word "duraluminum" is by no means a new one All of us recognize it as the name of one of the newer alloys The very fact that there is such a vast number of these, however, is apt to close our eyes to the importance of any one of them We are very apt to let ourselves be ruled by the impression that there is a new alloy every day, and that there is not much that we can say about any of them to make it stand out above the rest of them The real facts are, that some few of the metals put on the market within the past five years are of such character as to have made themselves already of fundamental importance in modern technology Of these newcomers by no means the least dominant is duraluminum, and we are very well pleased to have this account of it from one of those instrumental in its development. The text here given is adapted from an address by Mr. Stout before the American Society for Steel Treating —THE EDITOR.

A MATERIAL one-third the weight of cold-rolled steel yet with the same approximate strength characteristics a metal which can be heat treated to higher physical properties, yet by a process which does not take effect for an hour after treatment a possibility for much lighter and at the same time cheaper production in certain lines of manufacture, here in a few words we have a picture of the possibilities of the new copper-aluminum alloy known as "duralumin"

Receiving its first impetus in the development of aircraft abroad, and particularly by the Zeppelin firm, this metal has been perfected in this country to a point far ahead of the German product, while the work in connection with aircraft of both the airship or lighter-than air type, and the airplane or heavier than-air machine, has developed processes and methods now appli cable to new lines of production

The new alloy can be rolled into sheets or forged by hand press or power hammer It can be cast, welded and soldered, while rivets of the same material used with it show new production possibilities on account of the peculiarity of the heat treat resultants. Connecting rods have been made of it using the metal itself for wearing surface without anti friction metal These have operated successfully in both motor cars and air craft engines. Worm gears have been successfully used in heavy truck service against steel pinions Timing gears of this metal show new possibilities of both wear and quietness, but the most use has been in structural shapes for ultra light constructions. The metal costs about five times as much as cold rolled steel, but one-third the quantity is used for the same strength result, while the material being much easier to work than steel in most of its forms saves materially on labor, tool cost and tool depreciation, and on enough production items so that in many cases con structions can be made more cheaply of duralumin than of steel

The work we have been following has been entirely along the line of minimum weight structures of fairly large size for aircraft work The saving of a pound in an airplane structure means the addition of a pound of fuel in flight or a pound of pay load, so that in aircraft more than anywhere else minimum weight is a vital item Strength is, however, no less fundamental, as an airplane in flight at speed is subject to stresses far greater than those imposed on an automobile on the road or any form of present transport. Imagine having to build a motor truck of two ton capacity that could run across a plowed field at 70 miles an hour without breaking up. This alone would be some engineering problem yet some modern planes of the bomb-carrying type are designed to do, and do do this

Structures are now being built of duralumin which far exceed former strength figures in wood and yet which are lighter than any previous wood-and-cloth airplane constructions We have at present in process machines capable of carrying twenty passengers at two miles a minute for five hours and fitted with 000-horsepower engines, yet the whole machine weighs but the same as a moderately heavy touring car The entire secret of the weight result is, of course, not all in metal, but it is safe to state that the light weight figure could not have been reached with our present knowledge with any other known material

Many have preferred steel in their experimental aircraft work on the basis that steel in tensile strength was stronger than duralumin even weight for weight This is so, but the problem of strength in a structure is not ordinarily of tensile possibilities but of column or compressive strength

For the same weight, duralumin has about three times the thickness of even its cold-rolled boiler plate counterpart, and five or six times the section of alloy steels of high tensile strength The rigidity of a sheet is dependent on its thickness very largely, and while duraluminum is a much more flexible material than steel in equal sections, yet with the greatly increased sections used for equal strength a much greater rigidity is obtained than with steel

For example, we have produced a rolled section, designed for a maximum column strength, and yet of such shape as to fit production requirements. This section of .035 thickness of metal in a 19-inch column length weighs 7½ ounces and will support as a column 4 tons, plus. If made of steel of high alloy, its thickness would be, so far as tensile requirements go, about 009, a too great fragility to be trustworthy in a structure on account of the lack of rigidity of such a thin wall.

Duralumin, as we see it, looks very like aluminum, except that it takes a high polish, and that when pol ished the glinting red of the copper in the alloy can be detected The polish in ordinary atmospheres is permanent, the metal being non-corrosive to a high degree. In the tempered state it is almost impervious to salt spray, though in the annealed form salt water affects it.

The chief difference between this and previous aluminum alloys is its property of having its physical characteristics materially changed by proper heat treatment. This heat treatment in itself acts differently than with other metals, leading to some peculiar production possibilities.

Like all new things, this metal with its peculiar properties has certain assets and definite liabilities, but even its liabilities, in some cases, can be termed a profit, provided the structures made of the metal are designed to fit the peculiar requirements of the alloy

The most marked difference in the metal is that the change in physical properties following heat treatment is not instantaneous, but very gradually arises to a maximum after about four days, and during this period not only is the tensile strength increased as high as 50 per cent or more but the elongation increases from 600 to 800 per cent More than this, the metal in its heat-treated form can be reheated and softened for passing through mechanical processes of not too violent a nature, and at the end of one hour come back to its original tempered characteristics. The fact that the extreme properties of the metal are not reached immediately, as in most metals, is of great advantage commercially, as it will be explained later

The heat-treatment of the metal, or tempering, as it might be called, consists of heating the metal to 920-940 degrees Fahrenheit for from 7 to 30 minutes, the time being governed by the amount of metal in process. The material is then quenched in boiling water It is then removed from the quenching bath and worked upon as soon as possible In from one to two hours' time enough hardening will have taken place so that it will be difficult to work the metal Where the time involved in making up the piece does not exceed one hour and where the bendings or hammerings are not too severe, this process is in every respect a thoroughly feasible production method

This allows us in our airplane work, for example, to heat-treat a coil of sheet metal in a bath of sodium and potassium nitrates, quenching in an adjacent tank of boiling water and uncoiling the sheet or strip, start it immediately through the rolls which form it into the shape desired, having our complete process over and the spar ready for aging within 20 minutes from the beginning of the operation.

It is not my intention to go into any of the technical details or metallurgical study of the scientific side of this new alloy, but rather to point out the numerous possibilities opened up by its use and to describe and explain some of the results and processes now being obtained with duralumin, primarily in aircraft work. I will only state that the metal itself is nothing other than a copper-aluminum alloy, the copper running about 4 per cent, and some magnesium, but with zinc as the most detrimental component. For this reason, duralumin is made only from the purest 99 per cent aluminum, so that the impurities in each of the alloys from which the metal is formed will not build up a detrimental quantity. It is the inability of the Germans to obtain pure aluminum which has hindered their duralumin alloy from equaling the figures obtained in every-day production from the American product.

In the early metal, considerable trouble was had with corrosion and with sheets, seemingly without reason, granulated, and until the properties and difficulties were worked out, structures built of the material were more or less uncertain and required frequent inspection. This is still true in very thin gages which are not very carefully heat treated, but with pieces of any real section corrosion is now an almost unheard-of thing

The main trouble had with duralumin is more or less similar to the problem met in other alloys, that is, the presence of impurities in the ingot, or air bubbles, small in their original forms, but which, when worked out and forged into thinner sections, developed into serious defects.

Most of our material is of 035 stock, so that a very small speck of dirt can make a serious flaw in the metal sheet and a very small air bubble can make a considerable pipe in the center of the sheet, almost impossible to find except by microscopic examination, added to considerable good luck

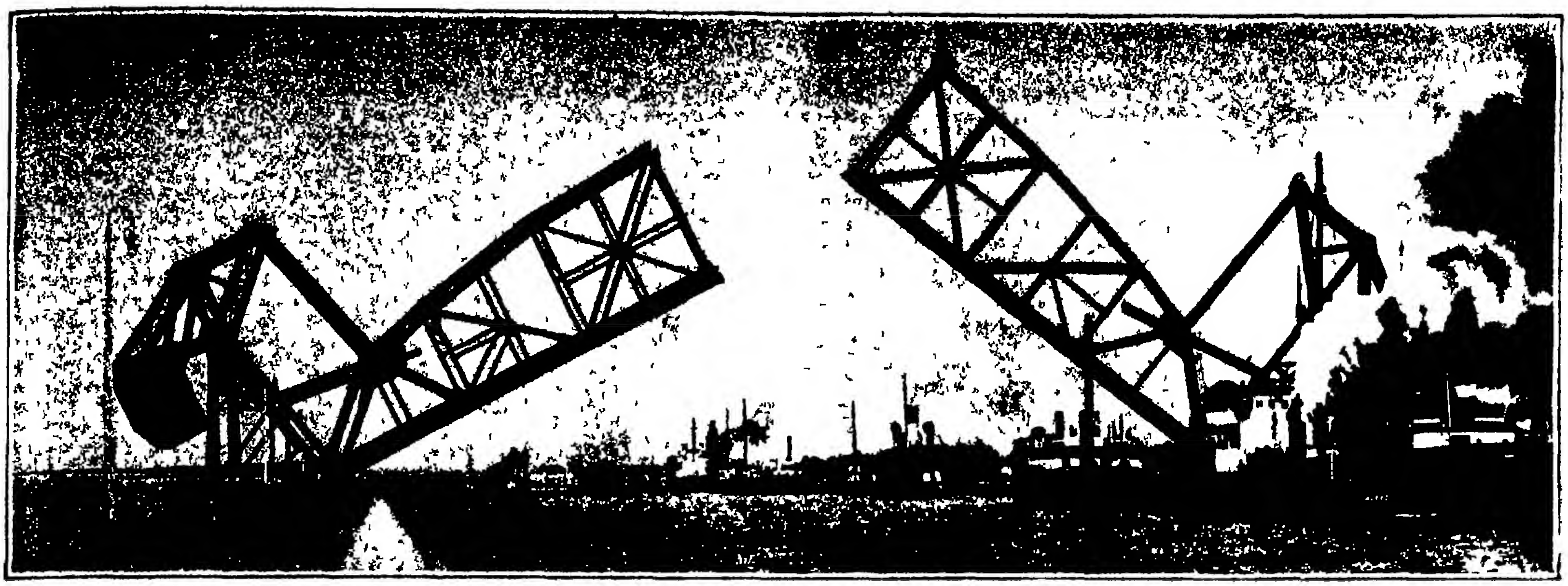
Most of these flaws do not show up until after the rolling. In this case the greatest stress on the metal in putting it through the rolls is at a hidden point, so that to inspect these spars or chord members a dental mirror is used with a high light, and the surface very carefully examined. Frequently a hole as small as the point of a fine needle can be opened up into a flaw five inches long—a sort of stratification of the metal resulting from original ingot impurities.

At the beginning of our work, spar rejections, for this reason, ran as high as 400 per cent of the accepted pieces. This was gradually reduced, and it seems possible in the near future that our rejections will be normal In all these sections there has been no attempt at drawing the metal, but merely bending it, as any attempt to draw the metal results in an extreme number of rejections through cracking It is peculiar that these cracks may not appear until a number of hours after the piece is made, so that after rolling four days is allowed to elapse before parts can be inspected for cracks or flaws and before use.

The great drawback of the material as we are using it at present is the presence of ingot flaws, rolled out in the sheet, which lead to a very high rejection cost. When this is cured, we can say, I believe, that the experimental stage of duralumin is over As soon as quantities of the material are demanded also rolls can be put in for greater widths of sheet than at present available—sixteen inches being now the best obtainable—and tubing and other structural forms can be made available.

I believe that this material, and developments from it in better alloys, will eventually be more universally used than steel for structural requirements. Its use in aeronautics is already definitely established, now as it is, and the all-metal plane already given preference to the older types. I believe we will next see it in motor cars, at a saving of over half the weight, and in boats and buses, street and railway cars, bridges and girders. For the time being, however, it is a material to watch and sutdy, and to make use of conservatively. I append a table of its physical properties.

Specific gravity	2.80
Weight 102 lbs. per cu. in.	
Melting range, Centigrade	540 to 650
Compressive strength tempered	44,000
Shear value tempered	30,000
Tensile strength tempered	50-60,000
Per cent elongation tempered	18 to 20
Modulus elasticity	10,000,000
Coef. expansion	.00000226 per ° C.
Yield Pt.	36,000



Bascule Bridge across the St. Mary's River, in the raised or open position to allow passage of shipping

Failure of St. Mary's Bascule Bridge

How a Girder in the Counterweight Truss Gave Way and Stopped the Bridge Traffic

By August Kuhlmann

RECENTLY a member in the counterweight truss of the large railroad bascule bridge across the St Mary's River gave way and all traffic across the bridge was stopped. The break took place in the member BF only a short distance from point C at D, as shown in the diagram below

The failure came about in the following manner: At a change of shifts the bridge was open, and on starting to close it the operator heard pieces of cement falling Stopping the closing operation, he went out to investigate and found a one-half-inch crack in the concrete. The operator, after notifying his superior of the break, received orders to lower the bridge to let a train pass. Finding the crack opened up more the bridge was again opened. While again inspecting the crack with the bridge completely open the steel members were heard to snap and one after the other of the plates and angles making up the broken member gave way

The girder is made up of four 4-inch by 4-inch by ¾ inch angles riveted to two 28-inch by ½ inch plates separated by ½-inch webb and lattice members, as shown in the illustrations. The member CF, which is 28 feet long, has an area of 70 square inches and a calculated unit stress of 16,000 pounds per square inch under tension.

In breaking, the member CF not only pulled apart but also moved out of line, as shown in the illustrations, point D being higher than C. In addition the counterweight G swung over so that it was binding on the column on the opposite side, corresponding to BN This caused the members on the opposite side corresponding to EF and BF to be bent out of line by at least four inches at the lower extremity, straining them considerably It was feared that they also might break. In order to make repairs to the broken member it was necessary to get the member BF in line again The plan decided upon was to lift the low edge of the counterweight, so that it would not bind against the column, and then lower the bridge, supporting the greater part of the weight of the counterweight on jacks, so that the weight of the counterweight itself would force the broken member into line and also close the break.

Heavy timbers and jacks were therefore placed against the NM face of the counterweight; but it was found that instead of lifting the counterweight to any extent it just pushed it in toward the left. Jacks were therefore also placed against the G face and at the corner, to prevent this horizontal motion backward. The jacks were not powerful enough for the work and operations were halted until ten 100-ton and fourteen 50-ton jacks were secured With these the counterweight was righted

The electric drive for operating the bridge, which applies power to the rack H through the pinion P, could not be used, as the counterweight truss would be strained too much and at best the speed of lowering would have been too fast and jerky, and it was necessary to avoid strain as much as possible The bridge was lowered by exerting pressure with the jacks on the MN face of the counterweight, until the jacks began to tip slightly, and operating the pinion P by means of hand gearing, blocking the counterweight in position, getting a new hold with the jacks, and repeating the operation As the bridge was lowered the jacks followed up the counterweight and had to be continuously moved up and out As a precautionary measure in case the pressure on the counterweight should overbalance the bridge and let it fall two cables were fastened to the upper end of the leaf and led to winches. No tension was kept on the cables, but it could be applied at any moment. This precaution was found to be unnecessary

The plate of member CF which was embedded in the concrete was found to have elongated considerably and its length was cut down to an equal amount The outside plate was not elongated The outer plate broke in more or less straight line while the plate in the concrete had a rugged break

As was expected, when the bridge was finally lowered the broken member came into line and the gap was also closed, due to the compression on the member

When the bridge is closed the member CF is under compression, when open it is under tension The maximum tensile stress was calculated to be 833,000 pounds and that on compression 1 107,000 pounds using a 33 per cent impact stress when the bridge is closed The member was designed for this maximum compressive stress. Several years ago the member BC failed just above C and this member was reinforced but the reinforcement did not extend to the present break. Several other bascule bridges have failed in the same place

Trains were allowed to cross the bridge as soon as the broken leaf was lowered, but as nothing except the compression on the member BF held it in place the leaf could not be raised except a slight amount to allow the other leaf to be raised By operating only the other leaf and using tugs to keep the boats clear of the broken member neither rail nor water traffic is interrupted.

The broken member has been joined temporarily by riveting angles across the top of the broken angles also two patches were put on each plate Two patches were used in place of one in order not to take out any more rivets at one time than necessary in order not to weaken the plate any more than was necessary

In order to take as much strain as possible off the broken member until permanent repairs are made during the season when navigation is closed cables were placed around the counterweight as shown in the illustrations Cables have also been placed around the counterweight on the other leaf to prevent the same accident there

Permanent repairs will be made to both leaves The exact nature of these repairs has not been decided on but probably the whole broken member will be replaced by a stronger one

Specimens of the steel were taken for examination to determine if the material was at fault Announcement has not been made of the results of this investigation

The counterweight, which weighs 2,290 000 pounds, is provided with doors, so that weights may be placed in its hollow center for adjustment In the summertime the bridge floor dries out and to maintain the balance extra rails are laid on the floor In the fall as the floor grows heavier with moisture they are removed

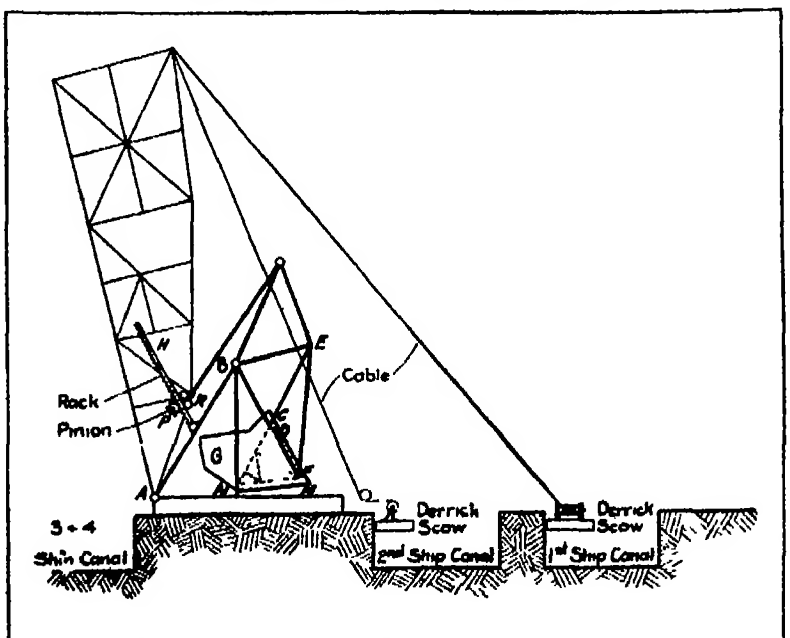


Diagram showing one-half of the bridge open, and the point D at which the steel member CF parted, disabling the bridge

In order to take care of expansion and contraction of the leaf the whole leaf as well as the counterweight truss is on rollers and the leaf can be moved forward or backward by means of hydraulic pressure.

The Oppau Disaster: Facts and Conjectures as to Its Cause

By Paul J. Mallmann, D.Sc.

ON Wednesday, September 21st, at 7 32 A. M., two successive detonations shook the entire district of Ludwigshaven and Mannheim, in lower Baden. The second was of terrific violence, virtually razing to the ground not alone the major portion of the Badische Anilin und Soda Fabrik chemical works at Oppau, in which it occurred, but devastating the entire village as well Fortunately the explosions occurred when the men as a whole were not yet in the plant even so, the final returns showed 426 killed 100 missing, and no less than 1952 wounded.

To understand the circumstances leading up to the disaster it is necessary to review shortly the work of the Oppau plant This is one of the big German centers of fixation of atmospheric nitrogen During the war the ammonia thus obtained was employed for the production of niter to be employed in the manufacture of munitions. On the conclusion of hostilities the plant was restored to the purpose for which it had been built in 1911-13 the manufacture of fertilizers. Prior to the war the question had arisen as to the form in which nitrogen salts might best be put on the market for this use The German farmer has become rather accustomed to the use of ammonium sulfate, and it appeared a simple problem to the Badische company to exploit their Haber-Bosch process, by which the atmospheric nitrogen is converted into ammonia gas, by passing this gas through sulfuric acid and producing ammonium sulfate in competition with the gas works and the by product coke-oven

Unfortunately, as the author has shown ("The Recovery of Sulfur from Blast Furnace Slag," SCIENTIFIC AMERICAN MONTHLY, October, 1921), Germany imported annually prior to 1914 some 1,250,000 tons of iron pyrites, sulfur blends and other raw materials used in the production of the universal acid This supply was cut off by England during the war, and afterward such circumstances as the low value of the mark the high cost of transportation and the exorbitant price of the commodity as such, made it out of the question to return to the importing of the pyrites To avoid the consequent heavy increase in the price of sulfuric acid the Badische plant has developed an alternative process for the production of ammonium sulfate which does not require the acid at all but makes use instead of the calcium sulfate or gypsum which is present in Germany in inexhaustible quantities. By a simple chemical process the calcium is displaced by the ammonia, and the desired product obtained

Another nitrate fertilizer of established reputation is ammonium nitrate Just as the sulfate is obtained by passing ammonia gas through sulfuric acid, so this is made by passing the gas through nitric acid. It is, speaking strictly from the chemical viewpoint, a more advantageous foodstuff for plant life than the sulfate or chloride of ammonia and it is necessary for a plant like that at Oppau to give attention to its manufacture. But ammonium nitrate possesses properties which do not permit its use without further precaution. It can not be stored because it "deliquesces"—*i.e.*, it absorbs water from the air until it dissolves into a liquid form; and under certain conditions likely to arise in its use, it develops pronounced explosive qualities.

During the war, when everything connected with sulfur was so valuable, efforts were made to substitute the nitrate for the sulfate in the fertilizer industry by eliminating these objectionable qualities. These efforts took the direction of chemically modifying the nitrate with the object of retaining its fertilizing value while dismissing its objectionable qualities. Thus a potassium ammonium nitrate was obtained which served very well, except for the fact that the potassium itself is an active fertilizer, and one which the farmer might well object to paying for when he did not need it A calcium-ammonium nitrate did not give satisfaction in use Finally, with the coming of more nearly normal times, it became possible to use sulfates once more as fertilizer, and the problem of the utilization of ammonium nitrate was met by the combination of the nitrate and the sulfate into a nitro-ammonium sulfate.

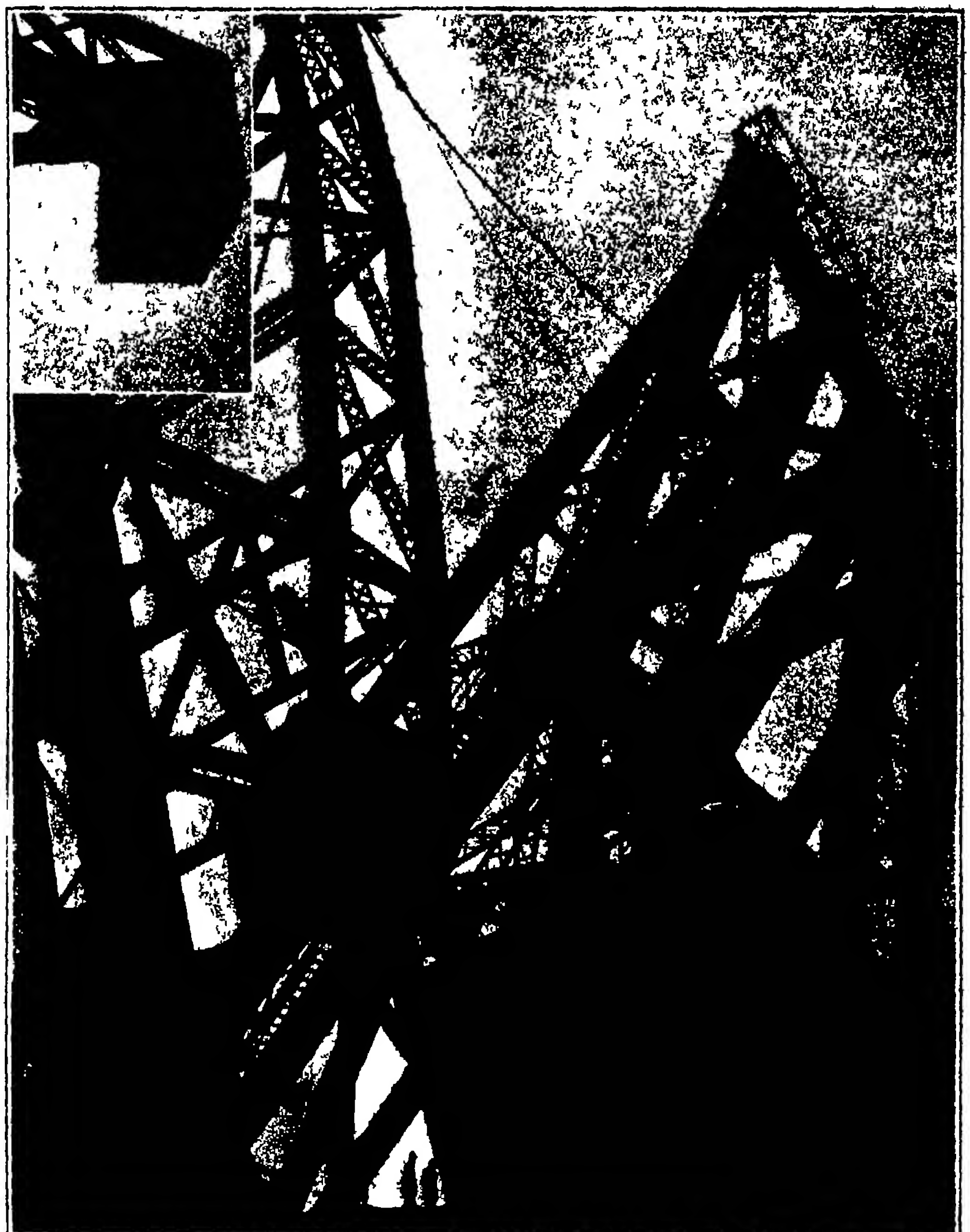
All fertilizers must be manufactured throughout the year for obvious reasons of industrial economics; but the farmer has a firmly rooted habit of buying them only during the few weeks when he is about to use them. This means that the factory must store vast quantities of the material The Oppau plant met this condition by the use of large, well-constructed silos, where the nitro-ammonium sulfate described, which had become definitely one of their major products, was accumulated against the coming of the buying season. These silos were originally equipped with large dredgers for the loading and unloading of their contents. But during the months that elapsed between storing and removal, the salt, heaped up to heights of 45 and even 60 feet, developed great pressure. The lower portions of the mass were compacted by this pressure into a hard, stony mass which turns the dredger without effect. At first it was supposed that this could be handled by sending workmen in to break it up with pick and shovel; but it was quickly learned that the mass was not solid, and that the cave-ins caused by the empty spaces were a source of injury to the laborers.

To meet this situation the management decided to blast the material loose. Powerful explosives were not required, since the cohesion of the salt was not pronounced. It was decided that the safety explosive of the coal mines, which blasts the coal without igniting any of the fire damp in the surrounding atmosphere, could be used with complete propriety To make the explosion most effective it appears that pneumatically-driven steel tools were used for the drilling of the holes in which it was to be placed. Both drilling and detonating were under the most competent supervision obtainable, as is evidenced by the fact that some 16,000 of these blasts were made without the slightest mishap. The management of the company, in fact, still takes the attitude that the cause of the explosion that ultimately occurred is a mystery The author ventures the following suggestion, based on his own experience with explosives extending over many years.

It is admitted that ammonium nitrate possesses under certain conditions explosive properties. It does not necessarily follow that an admixture of the sulfate with the nitrate in the presence of water will eliminate this tendency All that is necessary is to create the conditions required, and we shall have explosion These conditions are: heat, pressure, gas—and then a spark

The presence of pressure in a mass of more or less continuous material 60 feet high is obvious. That the substances with which we have to do will, under such pressure, produce a certain amount of gas is equally certain The continued generation of this gas, and its continued confinement, will produce heat. All that is now necessary is the spark. If we do not have a spark, we may very well subject the mass of nitro-ammonium sulfate to 16,000 violent upheavals without any unfortunate consequences. But this does not in the least assure us that, with a slightly different set of conditions, the mass will not explode.

To create the spark necessary to change the situation from one of safety to one of disaster it is at least conceivable that the safety explosive went wrong and did something which it is not supposed to do. Spontaneous combustion of the heated and compressed gases upon the introduction of oxygen through a drill-hole is another possibility. Their ignition by a careless workman's match, or cigarette as they escaped from such a hole is still another. The most probable hypothesis, in my mind, however, is that a friction spark was produced by the drill's striking the concrete side.



Close-up view of the disabled counterweight and its frame, weighing 2,299,000 pounds, with the bridge in the opened condition. The arrow at A shows the break extending clear through the member, which is 28 inches square at this point. The top left-hand view shows positions of counterweight when bridge is lowered. Note the cable lashings to relieve stress on frame

Learning While Earning

The Organization, Operation, and Results of an Automobile Factory Trade School

THIS is the story of a trade school which was organized at the Ford Works, Detroit, for the purpose of giving the boys in that institution an opportunity to continue their education, and at the same time to learn a trade that would give them more than an ordinary knowledge when they came to meet the problems of life in the great outside world. The school, which was opened in 1916, is regularly incorporated under the Michigan laws. Commencing with six boys and one instructor, it had developed by the year 1919 into an institution having 18 instructors, over 350 boys and a long waiting list

When a boy is enrolled he is awarded a scholarship amounting to over $400 annually For convenience, this is reduced to an hourly rate and is paid twice each month. A boy thus becomes at once self-supporting while attending the school, and this scholarship is increased from time to time, depending upon the progress and effort of the boy, until the maximum of $600 per year is reached As the scholarships are awarded on the yearly basis, the boys are paid for all holidays and vacations, including the summer vacation.

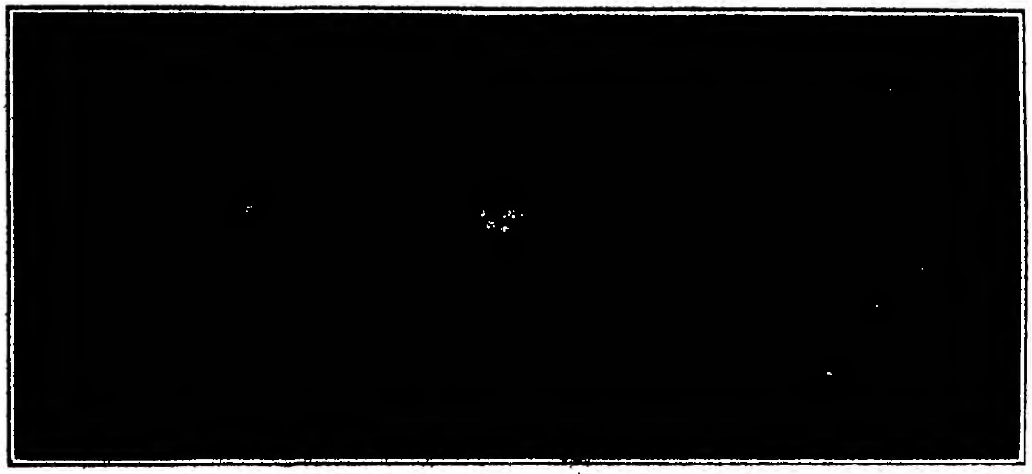
In order to develop a habit of thrift, one dollar is added to each envelope every payday This dollar must be deposited in a savings bank and kept there. Each month the bank books are collected for inspection, and so long as the balance shows that the full amount has been saved, the thrift fund is continued Many of the boys, encouraged by this incentive to save, have added materially to the fund from their scholarship payments.

A board of five directors directs the policy of the school, there is a department which undertakes the personnel work, enrolls the boys, investigates all applications for admission, keeps in touch with their home life, and gives them such advice as they may seek or as may be useful to them in many affairs of their daily life Occasionally it happens that suitable homes are found for those lads who may be thrown entirely on their own resources.

As soon as a boy is admitted he is given a thorough physical and dental examination. When it is necessary his teeth are repaired and he receives the proper medical attention. He is then assigned to a class according to the work which he has completed in the public school. The boys are divided into three groups, one of which is in the class room and two in the shop. Every week the groups are shifted, the boy who has spent a week in the class room enters the shop for two weeks, and one of the shop boys enters the class for academic work. It should be understood that, from the moment the boy enters the school he is engaged in useful work. Although it is true that the tasks are graduated according to the boys' ability, nothing is given to them for practice merely. Everything the lad makes or works upon is used, unless he spoils it, and he is kept at work on each operation until he has mastered the process.

Boys in school-shop, working on special machines

Expert mechanics, selected for their teaching ability, train and guide the boys and the results have been so successful that when they have completed the course the young men are capable of taking their places as journeymen in any tool room Those of the students who develop qualities of leadership are given proportionate responsibilities in both the shop and the class room. The work is so successful and the results are so practical that the graduates of the school are in demand in the various tool rooms of the Ford Motor Company



Class in mechanical draughting

The class of work covered is equal to that of the public school, eighth grade, except that the work is based on shop and tool-making problems. In the curriculum emphasis is placed on mathematics and mechanical drawing. The factory of the company is used as a laboratory, and groups of boys are frequently taken to various parts of the plant for observation and instruction Machines and details of operation are studied in detail It is a noteworthy fact that work completed in the trade school compares very favorably with the work done in the regular tool rooms, both with respect to quality and the time consumed, moreover comparatively little material is spoiled by the students.

Front facade of the Ford factory trade school

Atomic Structure

IN the August number of the new *Italian International Review of Science* Dr E. P Lewis of the University of California gives the following statement of the picture of atomic structure due to the work of Lorentz, Zeeman, Rutherford and Bohr "There is a central nucleus which may be a hydrogen or a helium atom or a combination of these with binding electrons, and with an excess number of positive charges equal to the atomic number as defined by Rutherford and Moseley Around this nucleus circulate one or more electrons in circular or elliptic orbits, which have radii several thousand times greater than the diameter of the nucleus. These electrons control chemical valency and emit or absorb ordinary light waves as they pass from an outer to an inner orbit or conversely Very near the nucleus and practically forming a part of it are the orbits of the electrons whose disturbance gives rise to X rays. It requires great energy such as that due to cathode rays with great velocities or other X rays, to displace these electrons. As shown by the work of Rutherford, the nuclei of the heavy radio active elements disintegrate spontaneously emitting alpha particles (helium atoms) beta rays (similar to cathode rays) and gamma rays, which are very short X rays. Rutherford has recently also shown that the energy of an alpha particle from one of the disintegration products of radium is sufficient to disintegrate the atoms of oxygen or nitrogen with which it collides, showing that they, too are built up of smaller parts, one of these parts being certainly hydrogen, and another probably helium It is highly probable that all the heavier nuclei are composed of hydrogen and helium units.

"With increasing knowledge of atomic and spectroscopic phenomena the Bohr hypothesis seems to present a more and more satisfactory picture of atomic structure Yet there are underlying this hypothesis assumptions for which we have no explanation It is as yet impossible to explain the existence of a finite number of possible orbits in such a simple atom as hydrogen unless we assume as do some physicists, that Coulomb's law ceases to apply at atomic distances, and is replaced by a law of force periodically varying in sign with the distance On the other hand Rutherford's study of the scattering of alpha particles in passing through matter seems to prove that Coulomb's law does hold good at distances less than the radii of the atomic orbits."

The Human Atmosphere

The Visibility of the Human "Aura" Demonstrated to the Layman

By Albert A. Hopkins

OUR earth, as it makes its diurnal revolution, carries with it a thin skin of air which starts becoming rarified when we go up a few thousand feet, at about seven miles above the ground the air stops growing colder, at 20 miles above the earth is the upper limit of twilight, and at 50 miles begins a region where the atmosphere consists chiefly of hydrogen Few of us realize that we are carrying around with us a somewhat similar atmosphere in which every person is enveloped by a haze invisible under ordinary circumstances, but which can be seen by special scientific means This mist, the prototype of the nimbus or halo shown in old pictures, has for a long time been manifest to certain persons possessing a specially gifted sight, who, in consequence have received the title "clairvoyants." It is not with these persons or their illegitimate practices that we have to deal It is a scientific phenomenon with which we are concerned and which has been carefully tested by real scientists of unblemished reputation

The writer has recently been enabled, through the courtesy of Mr J B Allison of Englewood, N J, to make an independent investigation of this curious subject. The unquestionable evidence of Walter J Kilner, electrical expert of St. Thomas' Hospital, London, as given in his book entitled "The Human Atmosphere," should at once set aside any belief that this is a by product of occultism or charlatanism Professor Kilner says, "Although at present it is impossible to say exactly of what the aura consists, yet I feel positive that we are dealing with an ultra violet phenomenon Some women have the power of changing the colors of their auras by voluntary effort (no man or boy has as yet been found to possess this faculty) and these hues unquestionably do not belong to the ordinary visible solar spectrum, so we must be encountering a second and higher spectrum having shorter wave lengths. The physical aura exhibits another interesting property inasmuch as it can be influenced by external forces such as electricity and chemical action Naturally a considerable amount of time and thought has been devoted in trying to discover how dicyanin affects the visual organs, but the explanation remains incomplete"

Photography may in time assist the experimenter, but the results are not satisfactory as yet The aura must be viewed through a color screen made of an alcoholic solution of dicyanin, a rare coal tar dye, and in practice two cells are used containing the light filter The modus operandi is very simple The observer holds the cell containing the liquid solution of the dye before his eyes while a focusing cloth or other medium cuts out the extraneous light This treatment seems to acclimate the eye for viewing the aura. Some persons require only a half minute, but the writer found that in his case a minute and a half was necessary The eye having been charged, as it were, or at least educated, all is now ready for the test. An ordinary closet lined with black textile-like velvet is satisfactory, the black of the closet itself being what is known as "Chevreul's black," according to the classic experiment in which an imp was cut out of a small black box, and the hole appeared much darker than the surrounding box Light must shine on the subject sufficiently to illuminate it fairly well, and subdued daylight or artificial light may be used

The hands answer very well for experimental purposes, although the entire body is, of course, more spectacular The human object, or patient (for this new contribution to science is valuable from a medical point of view), stands at least a foot in front of the background to prevent shadows or marks on it from producing an optical illusion. We are now ready for the demonstration.

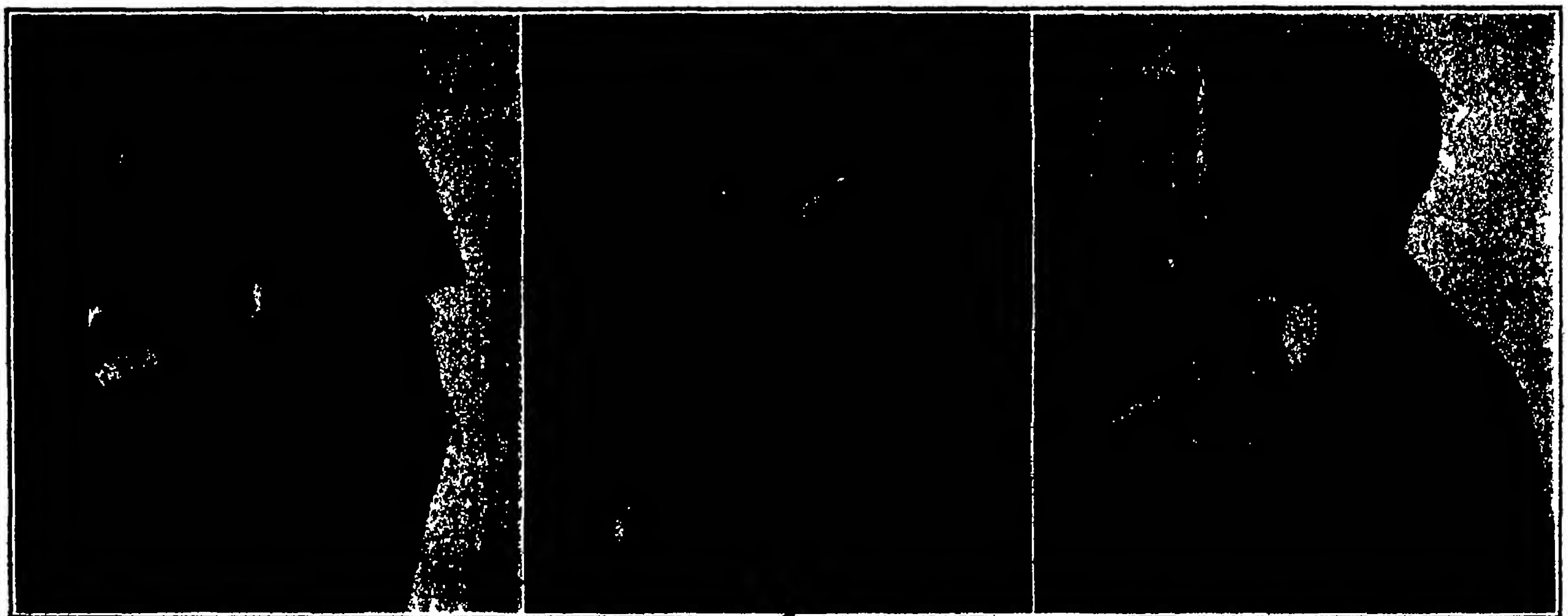
The observer will, as a rule, be almost immediately able to detect streaks proceeding from the fingers of the one hand to the fingers of the other, and a haze in the interval between the two hands. Directly he has perceived the haze and streaks, he will probably be able to see a similar, but not quite as plain, mist around the arm if bared Now and then there is some slight difficulty at the first trial, which can be generally overcome if the other hand is held at right angles, and a short distance from the arm. (See diagram 2) By this means the aura will be intensified, and when the hand is removed the observer will be able to see it round the bare arm Needless to say, as the eyes become accustomed to the subdued light the illumination will periodically require alteration.

A large percentage of persons after gazing through the dark dicyanin screen at the light are able to perceive the aura as described above, but a small minority find it impossible to detect it without the aid of the pale dicyanin screen It stands to reason that when this screen is used the light will have to be increased a trifle

After the aura around the arm and hand has been satisfactorily inspected the observer may with advantage inspect it through the deep carmine screen For this purpose it will be necessary to raise the blinds a short distance, until the arm and hand can be seen through the screen to the same degree as before He will now find that the larger portion of the aura has vanished, while the part that remains encircles the limb closely, being usually from one and a half to three and a half inches in breadth At a cursory glance the texture of this portion of the aura will appear more opaque, but when examined carefully will be found to be finely striated, looking as if brushed out with a camel's hair brush At places which vary from minute to minute, the lineation can be more easily distinguished than at others. The striated portion has been named the *inner aura*, and the wide amorphous part, not seen when using the carmine screen, the *outer aura*. At times, but by no means always, a close scrutiny will detect an apparently void space between the body and the inner aura. This area is called the *etheric double*.

It is imperative that the hands and the arms should be viewed exactly as if looking at a picture, there must be no straining of the eyes. The more accurately the observer can focus his eyes upon the plane in which the hands are held, the more easily and plainly will he be able to discern the aura. Straining the eyes is not merely a hindrance, but frequently will entirely prevent the perception of the haze

Directly the observer feels that he will be able to see the aura fairly easily he may proceed to examine it round a large portion of, or better still, the whole body. For the first trial it is preferable that the subject should be in good health and if possible robust, because the aura always loses in distinctness during illness. It is also useful to remember that the aura varies in clearness from day to day even in rude health.



Schooling the eye with the light filter — The phenomena is observed before a dark space — The glass cell containing the dye "dicyanin"

Investigating the human aura with the aid of a rare dye

While the subject is undressing and getting into position for examination the observer, unless he has previously done so, should look through the dark dicyanin screen at the light for a few seconds. The light must now be regulated by drawing down the blinds, when it will be noticed that the amount needed is much less if the whole body is being inspected than when the hands alone are looked at. Standing with his back to the window, and opposite to the subject (using a pale dicyanin screen if necessary), the observer ought to distinguish immediately, or certainly after a few seconds, a faint mist enveloping the body This varies even in health, according to age, sex, and individual peculiarities.

The first thing to observe is the texture, whether fine or coarse, as no two persons have identical auras. Note the color, which is generally some shade of blue mixed with a greater or less amount of gray A great help in determining the color is to get the person to place the hands upon the hips, and at the same time to extend the elbows, when in the space between the trunk and the arms the aura emanating from the body will be reinforced by that proceeding from the arms.

Such are the major facts connected with the human "aura" which Professor Kilner so strikingly describes, and his book goes into the subject in great detail, dealing with the aura of health, the aura of disease, the

(Continued on page 2[illegible])

The Service of the Chemist

A Department Devoted to Progress and Achievement in the Field of Applied Chemistry

Conducted by ISMAR GINSBERG, Chemical Engineer

Cider Preservatives

IN these days of prohibition cider must be preserved so as to prevent alcoholic fermentation from setting in. R. D Scott and E. G Will, in a communication from the State Department of Health of Ohio, report the results from experiments with the use of various preservatives in fresh and partly fermented cider. Sodium benzoate and salicylic acid were found to be of some value in preserving cider commercially, while 0.2 per cent of salicylic acid or 0.1 per cent of thymol preserved cider effectively for the purpose of court work

Illinois Potash Shales

IN Illinois there are localities where potash shales occur Potash shales are generally oil shales which contain a workable amount of potash The yield of oil from certain of these shales is large enough to render them interesting *from a commercial standpoint for that* reason alone, but in addition thereto they contain a sufficient proportion of potash to make them of very considerable industrial importance. M M Austin and S. W Parr of the University of Illinois discuss the occurrence, composition and utilization of these shales in an article appearing in the December, 1921, number of the *Journal of Industrial and Engineering Chemistry* In some places the shales contain as high as 5 per cent of potash, while the average proportion is from 2 to 3 per cent.

The extraction of the potash from the shale by the usual methods of leaching is impractical, because of the high cost and low yield However, there are certain shale outcroppings near Jonesboro in Union County whose chemical composition is such as to render them available for use in the manufacture of Portland cement This affords a means of recovering the potash, and it is estimated that by applying the known methods of potash recovery in the course of the cement process a yield of 5.3 pounds of potash per barrel of cement can be obtained.

Potash shales, found in certain parts of southern Illinois, with a content of 5 per cent K_2O, can be used directly as plant food About 62 per cent of the total potash is present in the form of glauconite, which is soluble in sulfuric acid.

Developing Photographs in the Light

R. E. CROWTHER in *British Photography*, 1921, No 3166, pages 3-4, discusses a new method of developing photographic negatives without the aid of the dark room. The process is one of desensitivation of ordinary plates and othrochromatic negatives by immersing them for about one minute in a solution of 1 in 2000 of phenosafranine. The developing is then accomplished in the regular manner by holding the immersed plate before a candle or an oil lamp.

Utilization of Wood Waste

THE Institute of Science and Industry of the Commonwealth of Australia has just issued a bulletin (No. 19) written by J. H. Boas, on the commercial utilization of wood waste, accumulated at sawmills, in the field and elsewhere, which it is estimated amounts to about 1,500,000 tons every year in Australia. There is advanced the proposition of erecting wood distillation plants which would take care of the entire Australian demand for charcoal, wood alcohol and acetic acid, which is now being supplied from external sources. Work has been done in New South Wales in connection with wood distillation, the results of which indicated that the yields of acetic acid and methyl alcohol were less than those obtained from European and American hardwoods. Particular attention is paid to the possible utilization of sawdust in the manufacture of industrial alcohol, paper, etc

Australian Pottery Industry

ATTEMPTS have been made for the past few years to locate a clay in Western Australia suitable for the manufacture of potteries. Such a clay has now been found and a small modern factory has been erected In addition to ordinary domestic pottery, sanitary ware and other classes of white earthenware will also be produced (Ind Abs. Aug 25, 1921)

Celluloid Rubber

THE finding of a common solvent for both celluloid and rubber has been a problem of long standing Dr Rudolph Dittmar in *Chemiker Zeitung*, 1921 819 to 820 and *Gummi Zeitung*, 1921, 30 to 40 volume 36, claims to have solved the problem by the use of the hydrogenated naphthalene product hexalin The hydrogenation of naphthalene yields quite a variety of products, such as tetralin, tetralin essence, tetralin extra or dekalin hexalin, heptalin, etc., all of which are available in large quantities in Germany About a year ago experiments indicated that these solvents would dissolve readily both vulcanized and crude rubber Not long afterward an investigation was started which resulted in Dittmar discovering that hexalin will dissolve both rubber and celluloid This is a momentous technical event, and affords a new field for the application of rubber as well as improving the quality of celluloid products.

The process, as described by Dittmar, appears to be as simple as it is effective Old moving picture scrap or celluloid scrap from plants manufacturing articles from celluloid, is mixed in an ordinary mixing machine of the Werner Pfleiderer type with the proper amount of hexalin A solution of rubber in hexalin is made in another mixing machine, then the two solutions are combined in a third machine Light-colored plantation crêpe rubber is used The mixed solution is then spread out on a glass plate and the solvent is allowed to evaporate. A very fine product is thereby obtained The properties of the rubber celluloid film may be varied at will by changing the proportions of rubber and celluloid in the mixture

Celluloid rubber can be used wherever celluloid itself is used now Its applications are therefore very numerous. When finely ground mica is mixed with the product—that is, mica in the colloidal state—then a mass is obtained which possesses excellent electrical insulating properties. By using a large enough quantity of the solvent a very high-grade lacquer, colored black if a dye such as nigrosine is used, is produced, which gives a film which can not be distinguished from that obtained with the famous Japan lacquer.

The handle and the stick parts of umbrellas and canes can be made in one piece by simply coating the end, which is to become the handle, with as many coats of the celluloid rubber lacquer as is required to give the desired effect The lacquer may be colored to suit the taste The elasticity with which the rubber endows the mixture is of considerable importance in the manufacture of photographic films, and it is likely that the new material will be of considerable use in that industry This property and also its resistance to wear and tear in the form of a film will probably be utilized to good advantage in the manufacture of artificial leather Artificial leather, as it now is made, consists of numerous superimposed films of nitrocellulose mixed with pigment and castor oil on a textile background It is conceivable that a nitrocellulose of similar nature to that forming the basis of celluloid can be used along with a certain proportion of rubber This would undoubtedly give films of far greater resistant power to mechanical abrasion and of considerably greater elasticity than the ordinary nitrocellulose film now used

The use of cellon and rubber instead of celluloid and rubber gives a mixture which in addition to the properties of elasticity etc is also non inflammable to a certain degree Cellon is the name given to a German variety of celluloid which is non inflammable It is probably a cellulose acetate product This mixture made into the form of a lacquer and admixed with pigments or colloidal aluminum can be used to good advantage in coating balloons and the wings of airplanes. The coating is perfectly impervious to the passage of gases and air Furthermore, the coating is fireproof which is of vital importance in both lighter-than air and heavier than air aviation

Zircon, the Mystery Mineral

AT a certain point on the coast of Florida there is a large body of sand which to the naked eye looks like any other sand that is so common at the seashore Recently a series of tests which were made with a view to ascertaining the properties of different sands gathered at different points along the seacoast from Maine to Florida revealed the astonishing fact that a certain sand contained large proportions of both zirconium and titanium After considerable difficulty the location from which this particular sand came was disclosed The land was purchased and steps were taken to mine the mineral A regular city was planned and erected, and today a large up-to-date plant is separating about 500 tons of ore daily

This deposit is unquestionably the largest deposit of titanium and zirconium minerals found anywhere The ores are very pure, and as there is no overburden, the mining operations are comparatively simple and easy to carry out. The deposit is said to be many miles in extent and is being worked now on a large scale with a probable doubling of the production within the next few months.

The importance of titanium lies in the fact that the oxide of this metal—that is, titanium dioxide—is a highly prized white pigment rivalling in its effectiveness and advantageous properties lithopone, white lead and zinc white In fact, the only consideration that has been retarding the more extensive application of titanium white has been the fact that it is more expensive than any of the other white pigments. The Florida deposit of ilmenite which is a titanate of iron, will undoubtedly result in a diminution in the price of titanium white and when that takes place titanium paint will forge rapidly to the front as the superior white paint

Zircon is a wonderful mineral and its proportion in the Florida deposits is not very much less than that of titanium It is a silicate of the metal and can be made into remarkable refractories in the form of bricks, crucibles, muffles, cements, etc It will melt at a temperature of 4000 degrees F, and the most corrosive slag will have no effect on it It is absolutely unattacked by acids and alkalies and possesses the wonderful property of neither shrinking nor expanding under terrific heat Wherever there is need for a material which must withstand excessive temperatures and corrosive actions of all sorts zircon is the material which will give very satisfactory service Its use has been suggested in making vitrified enamels, electrical porcelains laboratory apparatus, spark plugs pyrometer tubes, etc

United States Patents Nos 1 370 276 and 1,375 077 cover these applications. For further details see the November issue of *Chemical Age*

Gold and Silver in Shale

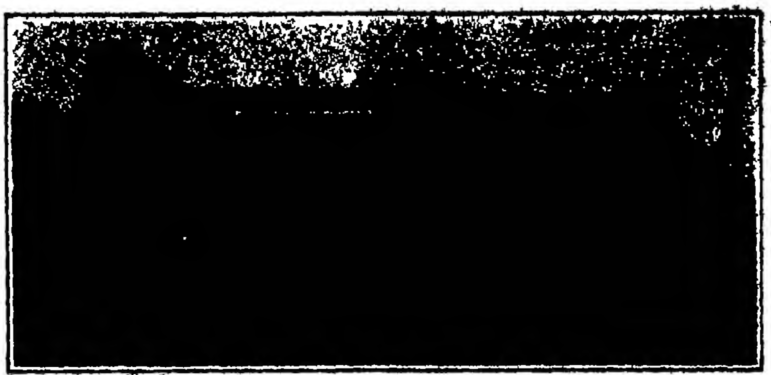
THE association between Colorado and gold and Colorado and shale is well understood, but the idea that gold and silver may be found in shale as well as oil is a new one The shale is distilled for its oil content and then the carbonized product is put through the cyanide process for its gold, silver and platinum content There is a good deal of skepticism being shown as to the practicability of processing the spent shale for the few grains of the precious metals that it may contain It appears quite certain, however, that colors of gold have been obtained in panning the spent shale. Developments are being awaited with much interest

Iron Portland Cement

THIS is the name given to a product made from ordinary cement and blast furnace slag, according to the *Chemical Age* of London The use of slag in cement is, of course, not new, but the interesting point in the article is that the cement is first made in the usual way from lime, silica and alumina, and then it is ground and mixed with not more than 30 per cent of finely pulverized blast furnace slag Far from being considered as an adulterant of the cement, the slag actually increases the tensile strength of the product, according to practical tests. The reason for *this is assigned to the fact that slag* contains more silica than the regular cement, and particularly in that the silica is in the form of calcium silicate, which on dehydration is converted into colloidal silica The efforts of cement manufacturers have been directed along these lines recently, and it appears that in increasing the colloidal silica content of cement the use of slag may be of considerable value.

Auto and Plane in One

FROM France comes the accompanying photograph of the latest novelty in aerial equipment The Pampier biplane pictured has cleverly adjusted wings that can be folded back against the tail section and out of the way This done, a second pair of rubber tired wheels is dropped into place, the motor starts, and we have an attractive automobile Land traction of this sort by means of an air propeller is not new—indeed we get it in every plane until the speed is reached which carries the machine clear of the ground, while strictly land machines of the sort have been put forward before This is the nearest approach that we have yet seen, however, to an actual combination of plane and automobile



Copyright, Keystone View Co.

According to the manner in which the wings and the extra wheels are used, this machine is an airplane or an automobile at the driver's pleasure

The Vacuum-Bottle Milk-Car

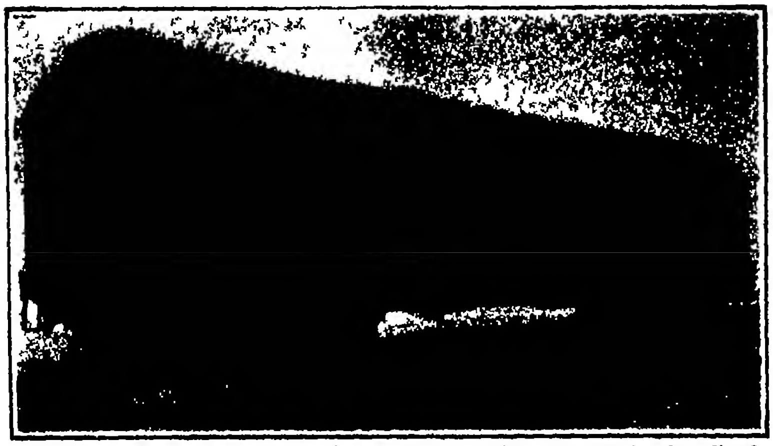
WHEN we go on a picnic, we take cooling liquids along in the vacuum bottle, we would not think of packing them with us in ice Yet when we come to the more serious business of transporting millions of gallons of milk to the city, we have retained the older and more cumbrous method just as though the vacuum bottle had never been invented

A Rochester, N Y, manufacturer of glass-lined steel ware is now offering a piece of equipment which we may well join him in characterizing as a "vacuum bottle car" Our picture shows the outside, with a phantom view of what it encloses Externally it is plainly just a milk car In ternally it is in very truth a vacuum bottle—just that and nothing more.

One s first impression would be that the first cost of such an outfit would be at least formidable and perhaps even prohibitive But just for the sake of argument, let us compare 100 50-gallon cans, of height four times their diameter, with a single container of the same capacity and the same proportions. We may be surprised on completing the calculation, to learn that the group of smaller containers will have a surface area including tops, 4 6 times that of the single large container We do not have any statement of the capacity of this tank car, but some such comparison as the one cited would hold. Moreover, a truck which is a miniature of the car is used at the loading end, and if necessary at the unloading end, so that the milk goes from the cow to the distributing station with two or at most three breakages of bulk

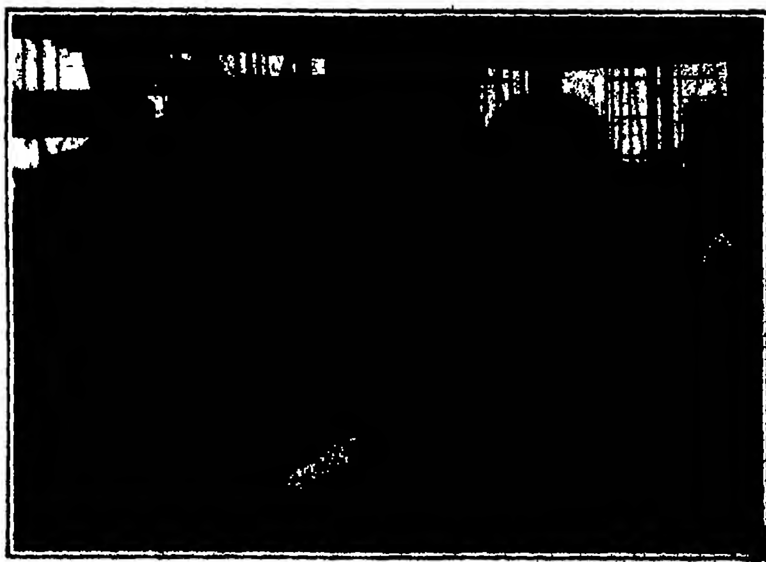
So we see that with the consistent use of these tank cars the cost of milk cans would be wholly avoided. The reduction in handling costs is alone such that one creamery was able to dispense with seven out of the eight men formerly thus employed The cost of cleaning is cut by a larger divisor than the one representing the ratio between the areas to be cleaned, since the size and the character of the inner surface of the tank car makes cleaning far simpler than in the case of the familiar can—indeed, it would be little exaggeration to give this comparison by saying that these factors make real cleaning possible where it has not been possible Another interesting item is in the waste through clinging of milk to the inner surface of the can With the old style cans, 150 gallons of the fluid are thus lost out of every 5000 gallons transported with the single large tank of the car this loss is cut to five gallons in 5000

It is pointed out that every dairy which has or can get direct access to the railroad tracks and which gets its milk from constant sources of supply can use these tank cars to advantage. It will be understood that, as is the case with so many other types of special cars for perishable foodstuffs, the shipper rather than the railroad is expected to own the cars, to look after their maintenance, and to operate them when they are not actually on the rails in a train



Phantom view of the milk car whose interior consists of a single glass-lined steel vacuum tank

The plow that pulverizes the ground, leaving it free from lumps and clods



The absence of corners enables this rock crusher to stand up much better under the severe strains of its heavy work

Recommended Specifications for Tires and Tubes

DURING the war, the Bureau of Standards was called upon by the Motor Transport Corps to prepare specifications for the solid tires used on army motor trucks. The results of this work were so satisfactory that similar specifications were prepared for pneumatic tires and inner tubes. Although prepared originally for the military service, these specifications became standard with a number of other government departments, and the demand for copies of them has been sufficient to warrant the issuing of Circular 115 of the Bureau of Standards on the subject. This may be purchased from the Superintendent of Documents, Government Printing Office, Washington, D. C., at 5c per copy.

As the preliminary work in connection with these specifications was carried out with the greatest possible care, and as the Bureau received the cooperation of practically all those interested in the subject, they may be taken as the best all-around specifications existing at present on which to base the purchase of rubber tires. The kinds of tests for tires of various sorts are described in detail as well as the quantity and quality of the materials which they should contain. The specifications for inner tubes are treated in the same thorough manner and the best methods of testing them are described.

The Pulverizing Plow

THERE is no fertility in a sun-baked clod, says the inventor of the combined plow and pulverizer illustrated on this page, and he has accordingly designed his implement with the view that it shall leave no clods to bake. The old method of harrowing and reharrowing the ground is intended to be done away with by this tool. With its use the earth as thrown up by the plow-share is caught by the pulverizing device and made as fine as meal, all in the single operation. The earth thus made and left moist and mellow is better adapted to quick germination of the seed than if prepared after the older and slower method, according to A. P Merrill, of Natchez, Miss., the inventor

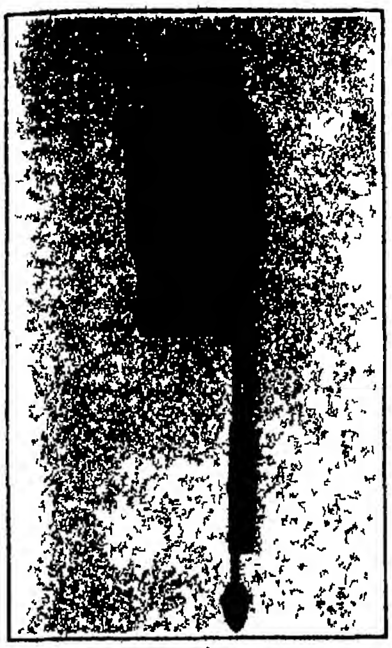
The Cornerless Rock-Crusher

THE use of jaw crushers of increasingly large size has led to the design of these machines with sectional frames; for the single-piece frame is unwieldy in large models, and its lack of rigidity, particularly at the corners, under the great crushing strains developed in rock-crushing has been a source of trouble. That the construction of the frames in four pieces has not met the latter difficulty is obvious when we find the technical press abounding with accounts of clever methods of effecting emergency repairs in broken jaw-crusher frames. The difficulty is one of faulty design, and should be corrected by the designer rather than by the user

The corner weakness of the four-piece frame has arisen mainly from the fact that, with the side frames grooved and the end frames mortised into them, bolts have been used to hold these members together The corner is the weak spot; and in a newly designed crusher it has been in large measure eliminated. The extremities of the side and end frames are made circular in section, the end frames fitting into the side frames and the whole being joined by a heavy steel pin. This results in the crushing strains being balanced throughout the side frames, instead of being localized in the corners. There are no corners or edges, and any slight departure of the end frames, which formerly produced a crack in the side frame as an immediate consequence, has now no effect whatever on the side frames, since the pin allows the freedom of movement necessary to relieve the situation without transmitting strain or motion to the side frames.

Inventions New and Interesting

A Department Devoted to Pioneer Work in the Various Arts and to Patent News



This socket gives the user a minute to leave, after which it turns off the light

The Delayed-Action Lamp-Switch

A LIGHT that stays lit after you turn it out is one of electricity's most recent developments. The advantages of such a light will be readily apparent to anyone who, in the sudden darkness, has stumbled over a chair en route to bed, or kicked over the waste basket on the way out of a dark office.

The lamp stays on for one minute after the chain is pulled. That brief illumination, however, gives ample opportunity to leave the cellar, to get into bed, to lock the garage or to close the office, in fact, to do any number of things that the darkness makes hazardous.

All this is made possible by an ingenious though simple and rugged thermostatic switch mechanism. The thermostat employed does not itself act as a slowly moving contact to break the circuit, but performs the function of a spring latch, which, when cool, permits the leaf contacts to snap apart.

Heating of the thermostatic latch is accomplished by a small resistance unit which is thrown into circuit by pulling the socket chain, as if to turn out the light. The positiveness of the switch action is such that it can plainly be heard across an ordinary room at the time the light actually is extinguished, 60 seconds later.—*By Fred G Jopp.*

For more economical use of laundry soap

Aluminum Economies

AN investigation of scrap losses in aluminum-alloy foundry practice showed that the annual losses in the United States amount to $1,200,0000 and that universal adoption of methods recommended by the Bureau of Mines would probably result in a saving of about $800,000 per annum. Melting losses in this industry, which are largely preventable, aggregate about $3,000,000 yearly

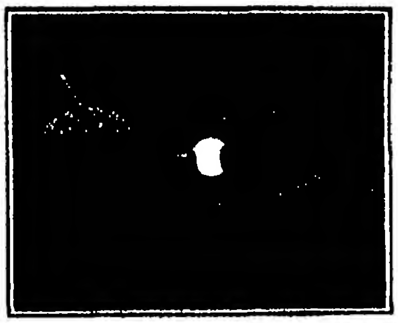
Something New About Inner Tubes

THE inner tube has always been carried heretofore in a flat case made especially for it. Now, they say on long tours these tubes rub against one another and this exercise is not good for them. This new metal box carries the inner tube slightly inflated, preventing friction when touring. A glance at it will determine whether it is in condition to use, for if there is no inflation something has gone wrong

A Lock to Carry with You

THIS lock can be used on any window by simply adjusting the screw as shown. It requires no tool, any coin carried in the pocket will do the adjusting.

When it is in place on a window the harder the window is forced from the bottom the tighter the lock is forced against the upper sash. To release, the locking lever is pulled back. It is especially desirable for bedroom windows on the ground floor, as it allows them to be open from top and bottom, yet locked



This lock locks the window open, and a key is always at hand

It Slices the Soap

HOUSEKEEPERS will be interested in this invention, which has for its special feature the saving of soap for laundry purposes.

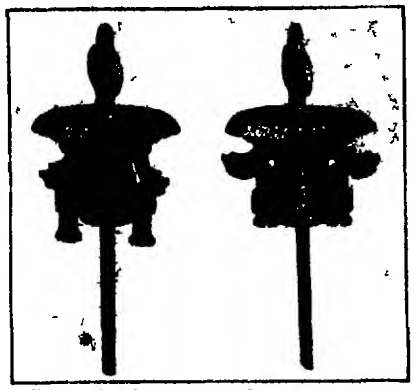
In most washing machines and the common boiler, soap must be cut into small particles. This machine will shave a bar and in doing so will get more soap than by the old hand method. It is not necessary to boil soap for washing, as many people do. It is claimed the boiling destroys the value of its cleansing power.

The cake of soap is inserted, and the handle turned. A guide feeds the soap to the cutter as each shaving is cut off.—*By H. M. Hunting.*

The Lock That Fits Every Door

THE fitting of a lock to a door has always been somewhat of a fussy job. We illustrate herewith a lock fitted with what the makers call an expansion cylinder, which automatically meets the difficulty by adjusting itself instantaneously to a door of any thickness. Instead of actually fixing the lock to the door the set screws of the new lock merely screw down upon two steel claws located on the inside of the plate and facing it. They are screwed down tight, with the effect of jamming these claws into the inner surface of the hole in the door. Provided the hole is of approximately the right diameter, it makes not the slightest difference how thick or how thin the door itself may happen to be. The thickness of the door plays no part at all, the claws gripping the inner cylindrical surface of the hole in a lateral direction. If the hole is lop-sided, even, this can be adjusted by loosening one of the set screws and tightening the other. Another inconvenience that is eliminated by this lock is that of fitting the set screws into the corresponding threaded openings in the cylinder—not an easy task when working in semi darkness.

This case keeps inner tubes in better condition, and indicates whether they are usable



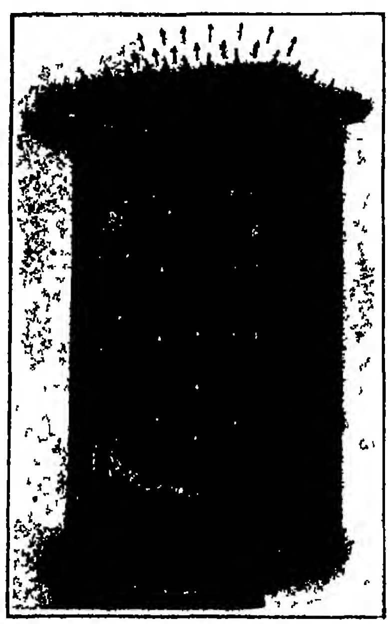
The lock that grips the side of the hole, before (left) and after (right) the set screws have been tightened on the gripping claws

Making Palimpsests Give Up Their Secrets

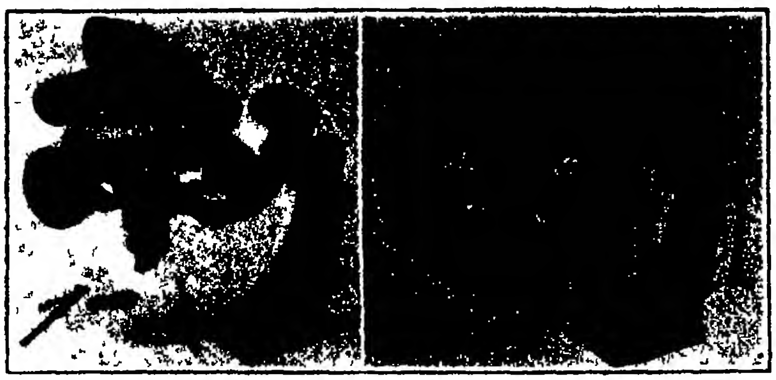
BY a curious trick of fate it seems that in almost every case where a palimpsest is dealt with, the old effaced manuscript is of far greater interest than the new one. Why it should always have been the case that a Virgil or a Cicero original should have been cleaned off in order to get paper for a personal document of absolutely no significance, instead of the reverse, is a mystery in probabilities, but none the less accords with the facts. Palimpsests are photographed in the ordinary way, with the use of color filters with ultra violet light, and now a third way of going about the business with the aid of fluorescence is being developed in Germany. Illuminated by ultra violet radiations of 334 millimicrons from the quartz-mercury lamp, the parchment fluoresces, but the erased writing remains dark. This fluorescent photograph often brings out details not disclosed by other methods, and has much improved the technique of examining old manuscripts.

The Pipeless Heater

A HEATER embodying a pipeless system with a series of inner chambers for recirculation of heat whereby coal is saved and thorough and uniform heat is given, has just been placed on the market. The only pipe connected with this new heater is the smoke pipe. Within the heater there is the usual fire pot. Through the medium of only one register to which the heater extends every room in the house can be heated thoroughly and uniformly. The register is connected directly with a double chamber of the heater. The inner chamber carries up the heated air which is automatically distributed throughout the entire house. The outer chamber carries the cold air down to the heater from every room in the house. The heater utilizes the principle of recirculation. As the hot air rises from the heater through the inner circular part of the register as shown in the accompanying illustration the cooler air is forced down through the outer part of the register to the heater. The colder air from every part of the house is attracted down through the register to the heating surfaces of the heater where it is heated and then rises and is diffused throughout all the rooms of the whole house. As the colder air is drawn out of the rooms the warm air is substituted and this process continues until the temperature is practically equalized through the entire house. There is a slight difference between the temperature at the ceiling and at the floor of each room which is sufficient to keep the air in constant but gentle circulation in all parts



The heater that works without pipes



The handy tire-building form, shown at the left with all sections folded over, and at the right with all closed

of the house. The recirculation feature of this heater permits the saving of fuel and the proper degree of heat at all times in all rooms. The heater is also adapted for stores, halls, garages, churches and schools.—*By A. H. Kolbe.*

A Job for Faucet-Power

FOR those washing machines that do not empty or fill themselves, this little motor has been designed. It will fill or drain a washing machine or the ordinary laundry tub where water must be carried. The device comes complete with attachments and its inventor claims for it that a stream of water the width of a match will do the necessary work. It takes three minutes' operation of the pump to either fill or drain a tub of water of the ordinary size. The water-faucet motor recently put out by a French inventor was, of course pitifully inadequate to do all the work that was claimed for it, but the present device should easily be able to set up the preliminary flow necessary to start the siphon action that will speedily empty the tub.

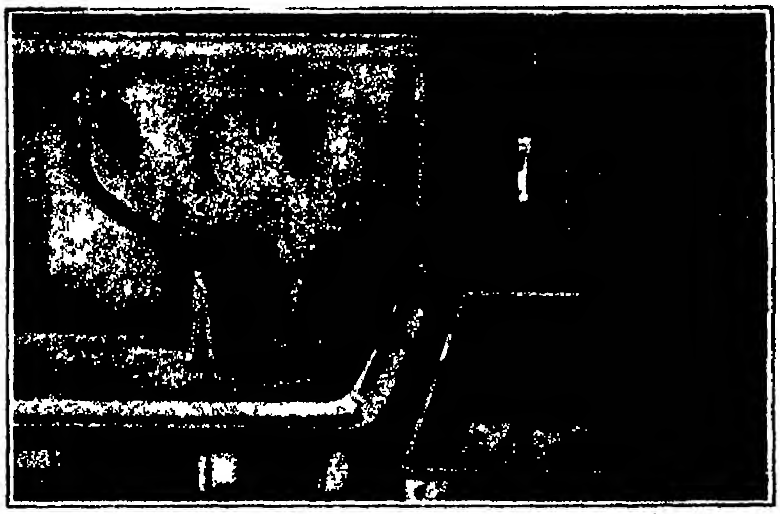
A Sanitary Catch-All for the Kitchen

THIS new sanitary kitchen catch-all is an accessory to good housekeeping that will keep the kitchen and the table refuse out of sight until it eventually finds itself in the incinerator or other means of disposal. A newspaper folded three ways makes a lining for this ref use holder. When ready for emptying, the contents are already wrapped for burning or for the refuse can. The cover fits tightly, keeping all odor within and all flies without. On every ground of cleanliness, convenience and appearance, it is superior to the familiar open bucket or wire sink basket.

The temporary resting place for kitchen waste, lost alike to sight and to smell

The One-man Tire-Building Form

THE job that usually takes three or four men to remove giant-sized truck tires from a building form can be readily handled by one man with this sectional form. This building form, developed by a New Jersey manufacturer is made in sections built on three radiating arms. One of these arms is a rack which may be moved by a pinion in the center of the device. When extended the sections fit together to make a form over which the rubber and fabric are placed. All the sections are folded over for removing the tire when the section attached to the rack is withdrawn after manipulating the rack and pinion gear with a socket wrench.—*By Allen P. Child.*



Faucet-motor for emptying wash-tubs without lifting them

Doing Away with the Scissors Grinder

SHARPENING tools, or getting them sharpened, is a great nuisance to the average mortal, and we are led to suspect that one reason for the success of the safety razor is the possibility which it introduces of discarding the old blade in preference to getting it in order again. And just as this is the first real improvement in razors since old King Louis the IXth—or was it the XIth?—felt moved to trust his barber and his doctor alone, of all men, so the corresponding innovation which has just appeared in the scissors may be hailed as the first improvement in this familiar tool since the days when Delilah used it with such effect. The new scissors is built in such a way that the old blade can be removed and a new one substituted by turning a few screws. The body of the two blades is not removable, and does not play any part in the cutting operation. The thin razor-like blade which screws on to the backing provided by the heavier part is the sole business member of the scissors under the new dispensation. The advantage is even more pronounced, we should think, than in the case of the razor, for one can sharpen a razor blade acceptably, if one is put to it, but we have never yet seen a scissors properly sharpened by an amateur.

A Dark Room That Fits in the Coat Pocket

A DECIDED improvement has been scored in daylight developing by the introduction of a new process for which Mr. E. J. Sweetland of Hazleton, Pa., is responsible. Not only does this process eliminate the necessity of the usual dark room with all its paraphernalia and mess, but it has a number of distinct advantages over the usual daylight methods of developing roll film, among them being compactness, extreme portability, neatness, efficiency, and ease of handling.

The basis of this new method is a long rubber bag, which is shown folded in the accompanying photograph of the entire daylight developing kit. This kit and the new method of daylight developing have been invented by Mr. Sweetland. The rubber bag, when unfolded, measures about four feet in length, or sufficiently long to take a full roll of film of post-card size. The first step is to pull out the covering paper of the roll film until the end of the film proper appears. Obviously, the roll film is held tightly in order to exclude all possible light from the film itself. When the end of the film shows, the paper is cut off. On the end of the paper still remaining on the spool is fastened the chain with the ring at one end, while on the end of the film is placed a film clip, of which there are two in the kit. This much accomplished, the spool of film is placed all the way in the rubber bag until the closed end is reached; then, with one hand grasping the film clip through the rubber bag, and the other hand pulling on the ring of the chain and clip, the film is unrolled in the rubber bag and the paper and spool are removed. It is evident that no light can reach the film while it is thus being removed from its paper covering.

The scissors with removable blades that never have to be sharpened

With the film flat in the rubber bag, the next step is to place the remaining film clip at the free end of the bag, which is folded over so as to exclude light, but has remaining still a small free space to permit of introducing and removing liquids. Water is then introduced in the bag in order thoroughly to wet the film. By passing the hand over the rubber bag which is resting on a table or other flat surface, little ripples or waves cause a constant agitation of the liquid within the bag. The water is then removed, and the developer is introduced. However, since it is impossible to note the progress of development, the so-called factorial system is employed, that is to say, with a known strength of developer, the temperature of same is taken, and according to the temperature a certain length of time will be required for correct development. This method is an absolute one, it makes no difference whether one is watching the process or not. The film might be over or under exposed, true, but that would not help matters any, hence it is best to go by the watch in obtaining proper results.

The developer is caused to flow back and forth by passing the hand over the bag. When the proper length of time has been attained the developer is poured out and water is introduced for rinsing purposes. Then the film, already developed, is removed and placed in a bath of hypo for fixing purposes. This latter operation can be done in broad daylight. The final operation is the thorough rinsing of the film.

This little kit is a complete developing outfit for roll films and makes possible the developing of films anywhere and by anyone

Replacing the time-honored procedure of attaching wax seals by hand

The Electric Sealer

THE royal seal of the most puissant monarch that ever lived used to be attached to the documents of state by means of a lighted taper, which, smoking with acrid pungency, released the heavy drops of wax from the lump held in the hands of the royal secretary. Into the soft mass then the engraved insignia was pressed, and if the worker was quick enough he did a fairly good job despite the very clumsy process. Until recently there was no really great advance over this crude method.

Now, however, the complete job is done electrically. The device is attached to the electric light socket, thus quickly reducing to a molten condition the wax put into the pot. Below this pot there is a cup-like catcher, into which the molten wax flows when released. The insignia to be stamped on the envelope or document is engraved on the base of this cup. When the operator is ready he pushes down on a plunger at the top of the apparatus. This releases the molten wax so that it drops, the stamping face below, which up to this time is turned to one side, then is pointed straight downward, and as the pushing process on the plunger continues the wax is forced through the small openings, and when the plunger is released it will be found that a perfect imprint of the insignia has been made. This process can be repeated about once in five seconds, so that a dozen seals can be attached in a minute.

The photo shows the position of the various parts of the apparatus just before the plunger is pushed down.—*By H Purdy*

The blow-torch that needs no pump

A Pitchfork with Removable Tines

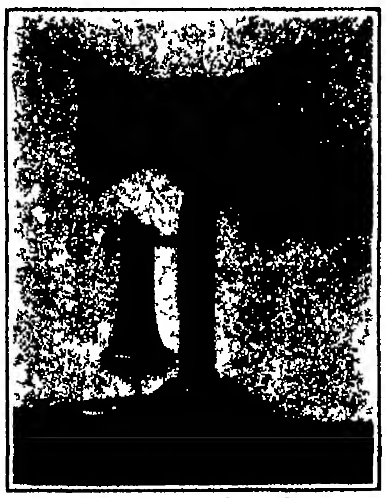
AN interesting and useful invention is that of Eric Luukkonen of New York, who has put forward a pitchfork with removable tines. Most of us have seen forks discarded, or used with such ill effect that they might better be discarded, because of missing tines. A fork constructed according to this patent may have all the tines removed and new ones substituted, or where there is but one tine broken this may be replaced. In spite of their removability the tines are held in place so securely that there is no danger of their coming out during use. This invention gives the pitchfork an indefinite life, for the haft, the back bone that holds the tines, and the several tines themselves may all be replaced individually as they give out.

Feather-Weight Opera Glasses

OPERA glasses that require no more attention after once having been adjusted to the eye and the object and that are so light as to permit their support by the nose in the manner familiar to the wearer of spectacles, are the latest invention of John A. Weis of New York. The glasses are, in fact, made much like the ordinary spectacles, equipped with regular opera glass lenses embedded in a collapsible tube. They may be folded and carried in the pocket. Their weight is but two ounces, so it is plain that they will not become a burden to the nose.

The Self-Lighting Blow-Torch

AN automatic blow torch has just been put out by a Columbus, Ohio manufacturer. No pumping is required hence there are no dry pump-washer troubles. No blowing is called for. The torch, which will use gasoline, alcohol,



All the sound goes into the transmitter; none is heard in the room

benzine, naphtha, or other volatile fuels is simply lighted with a match, and in about one minute it commences to operate, and continues until the fuel is exhausted. The lighted match is thrust through the burner coil shown at the mouth of the torch. Inside this coil there is a wick which carries some of the fuel, in liquid form, to the flame. This is ignited, and kept burning partly by its own flame and partly by the match. By the time the match is burned out the burner will be hot enough to generate its own gas. Part of this will then be forced out through the aperture in the vertical section of the coil and the balance will be shunted into the body of the burner. The latter is gas tight, and serves to keep up a constant pressure, forcing the gas out through the aperture in the form of a long, pointed, intensely hot flame.

The Vacuum Brush

WE have had vacuum cleaners for several years past, to chase the dirt out of our houses without creating dangerous dust. Now comes the same principle applied to a brush. The new cleaning apparatus operates exactly like an electric vacuum cleaner, but it weighs less than three pounds, and has a distinctive feature in that it is possible to clean the dust-collecting holder by means of the device itself. A combination dust bag is in the handle of one design, and to clean this bag the end of the holder is removed, the switch turned, and the dust is blown out by means of the motor. For cleaning motor upholstery an auxiliary dust bag is furnished, likewise cleanable by blowing out with the motor.

Opera glasses worn like spectacles, leaving the hands free

The Silent 'Phone

A 'PHONE appliance that can be easily removed from or attached to the instrument, and that is also practically collapsible, completely shuts off the conversation from the hearing of anyone else in the room. The inventor claims for it that it absorbs all sound waves not essential to transmission, and that it provides in sufficient quantity and of clear quality sufficient sound for perfect transmission. In addition to this, outside noises are kept from being transmitted.

The instrument is made of thin metal, six sided, with grooves so that the several parts can be disassembled. The person using the 'phone has his mouth entirely in the good-sized receptacle provided for the purpose. This mouthpiece is of such a curvature that the lips are as close to the transmitter as prescribed by telephone companies. There is a sound wave absorption unit, renewable and antiseptic, at each end of the device.

It enables executives to carry on a private conversation even in a large office full of other employees, without the nature of his conversation even being suspected. At the same time the voice of the user does not disturb those working around him. The whole device may be sterilized in hot water.

New Automatic Electric Stove

ELECTRICAL stoves, a few years ago alike wasteful of current and unsatisfactory in their results on the food are gradually coming to a state of development that justifies the expectations of those who believe them the ultimate in kitchen equipment. One of the best designs we have seen is now offered at an unusually low price. It has thermostatic control of a new sort, in which the condition of the food itself plays a part in regulating the switching off and on again of the current. Briefly, when the condition of the oven or pot contents is such that steam is given off to a sufficient amount to be forced out under its own pressure through porcelain tubes in

The vacuum brush that cleans out its own dust bag

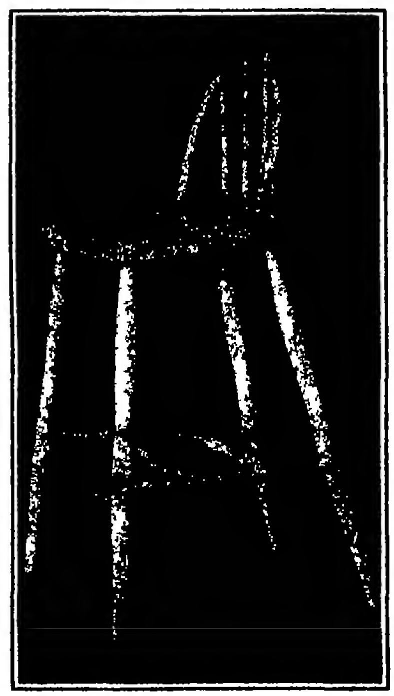
the side of the stove the steam thus escaping heats a thermostat. The latter is of the familiar variety which curves under heating and thereby breaks the circuit over which the heating current flows. Various special vessels such as triple-nesting pots are supplied with the stove. It seems to be one of the best electric stoves yet put on the market.

Scientifically Designed Work-Chair

HERE is a chair that has been scientifically constructed to meet the needs of the sitter engaged in a definite task. The purpose of the chair is to enable the woman working in the kitchen to perform her tasks at sink or at table while preparing vegetables, etc., with the minimum amount of fatigue.

Every angle of the human body while so engaged has been figured out for the construction of this chair. If a woman leans back in a chair while engaged in the kind of work mentioned above she will inevitably become exhausted much more quickly than she will if she inclines slightly forward. But this forward inclination also will prove exhausting unless the seat of the chair also tilts slightly forward. For this reason the front legs are made shorter than the rear ones. The seat of the chair is also scooped out just where the weight of the body comes and this also acts to prevent any slipping forward that might result if the chair were flat bottomed or if the entire surface were scooped out.

Because it is not essential that the back should be high, and because such a back would be in the way, a low one has been designed.



The chair that meets the worker's needs at every point

Cleaning ball bearings, gears and other small parts in a swift stream of gasoline or oil

How to Clean Shop Work

INSTEAD of cleansing shop work entirely by hand a device like the one illustrated can be utilized for forcing a stream of gasoline or oil upon small objects such as tools, drills, ball or roller bearings gears or parts of starting motors. Chips, dirt and other foreign matter are washed out and deposited on a wire screen below, the liquid returning to its source to be used again

A plunger pump operated by hand serves to force the gasoline through the apparatus. The handle of the pump is connected to the lid in such a way that the gasoline is never left exposed to the air when the cleansing machine is not in use In other words, the device is sufficiently fool proof to diminish the fire risks, for one of the fruitful sources of fires and explosions is the evaporation of volatile oils.

The machine is made ready for use by merely pouring into it a gallon of gasoline or oil and then working the pump while the part to be cleansed is placed in the swiftly moving liquid Fire underwriters heartily endorse apparatus of this kind because it eliminates dangerous and wasteful methods of cleansing.—*By H C Ridgely*

A Bumper That Locks the Car

THE cautious driver considers that he must have a bumper, and the cautious owner feels equally inclined to provide some means of securing his car against the activities of the person who might help himself to it. That both these ends can be served at the same time is indicated by the picture herewith which shows a combination bumper and car lock. The photograph shows the device in use as a lock, the two horns at the ends of the bumper being engaged with the wheel in a manner which would make driving the car in other than a geometrical straight line out of the question They are secured in this position by a standard lock, whose location is revealed by the key in the picture. When it is desired to retire them from action as theft-preventives, they are unlocked and swung down out of the way, adding a rather artistic touch to the fender

The bumper-lock in position to prevent the car's being driven When unlocked the horns swing down out of the way

A Cotter-Pin Extractor That Does the Trick

THERE was a time, before the advent of the automobile when nobody but the machinist was called upon to worry about cotter pin extraction, or to anathematize the fact that no means of holding a nut in position against vibration had been devised which was more easily removable when it was desired to remove it But with ten million cars in use in the United States alone it is now quite otherwise, and the bulky cotter pin must go down in history as one more sample of "the eternal cussedness of inanimate objects" and as a close competitor of the fugitive collar button and the barking dog in the provocation of profanity

Various tools have been offered from time to time for the extraction of the cotter pin Some of them have given reasonable satisfaction, others have not. Few if any have been at the same time so simple, so easy of operation, and so sure of producing results as the one illustrated herewith Our picture shows a test which we staged ourselves, and which is rather more severe than it appears. When a cotter pin is inserted in a hole that is part of a large bulky object like an automobile its removal consists for the main part in getting hold of it Once we do that, the inertia of the object through which it passes is such that a good pull is almost certain to bring it out or to break it off. The case is otherwise in our picture We have passed the cotter through the hole in an old rusty lock and we have not fastened the lock to anything at all Yet the long, tapering, horn-like member of the extractor gives such a firm leverage against this object, utterly lacking in inertia, that a good squeeze on the handles of the tool made the cotter walk right out as though the hole were anchored to the Woolworth Building, without the slightest tendency on the part of the hole to follow it and defeat extraction

As further test of this handy little extractor, we took it home and used it on our Tin Lizzie Any cotter that is not so badly crushed down as to afford no opening for the short prong of the extractor is completely at the mercy of the wielder of the tool. And for a rough and ready pliers or pincers job that requires no great accuracy of grasping—like twisting a jammed dust cap off the valve stem—it makes a very satisfactory pliers as well. On every ground it is a mighty handy tool to have around the garage

A successful test of the cotter-pin extractor that was more severe than a first glance would suggest

A Standardized Dish for Laboratory Weighing

A CHICAGO manufacturer has recently developed a standardized weighing dish for laboratory work. By averaging the weight of a number of dishes the standard weight is determined. Each dish is then weighed with the equalizer attached. This equalizer is in the form of an ear and fastens to the dish near the upper edge If the dish is found above the standard weight selected the cap of the equalizer stud is ground in order to remove enough metal to bring the dish to the standard weight. If the weight of the dish is below standard the cap is removed from the stud and powdered lead is placed in the tiny container until the weight is brought up to standard

These dishes are found most useful in making fat and moisture determinations in any milk product. The ear makes it possible to counterpoise each dish so that any number of dishes may have exactly the same weight The advantage of not having to correct a complicated series of weighings for the weights of the vessels is a material one.

The dish that is bound to weigh what it ought to

Characteristic Soft X-rays from Arcs in Gas Vapors

EXPERIMENTS have been conducted in which soft X rays having wave lengths longer than those previously known were produced and their wave lengths determined. These X-rays differ in many ways from X rays as probably understood. Thus, the X rays which were first discovered were remarkable for their ability to pass through solid bodies which were opaque to ordinary light All known substances, including even ordinary air, are, however, opaque to these soft-X-rays, which can only be detected by their effect upon objects located inside of the vacuum tubes in which the rays are produced. All of the chemical elements can be made under proper conditions to give off radiations which are characteristic of the element Some of these radiations are visible light, and some are in the range of X rays. The radiations here described are the softest, longest-wave-length X-rays characteristic of several of the elements.

Measurements have been made in 12 different gases and vapors. These experiments are of interest because they partially close the gap between visible light of the shortest and X rays of the longest wave lengths previously made. It has been known for a long time that radio waves and light waves are both electromagnetic waves differing only in wave length, and about 10 years ago X rays were found to be very short waves of the same kind.

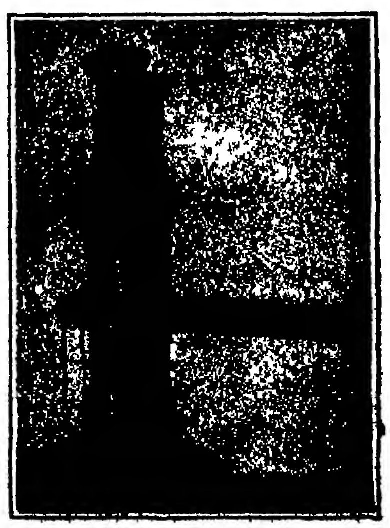
The radio waves ordinarily used are measured in meters, and there is only a very small gap between the shortest radio wave and the longest heat waves, the latter have a wave length of about 0.3 mm. From the longest heat waves down to ordinary light waves, which have a wave length of a few ten-thousandths of a millimeter, there is no gap, and, indeed, measurements in the ultra-violet have been extended down to wave lengths only a little longer than 0.00001 mm. There was, however, a gap between this and the longest known X-rays which were a little more than 0.000001 mm. in wave length The present measurements nearly close this gap as some of the X-rays measured are of greater wave lengths than are the shortest ultra-violet radiations.

Physical Properties of Pure Platinum

THE Chemical Division of the Bureau of Standards in cooperation with the Heat and Optical Divisions, has developed methods of obtaining platinum and some of its alloys in a state of extraordinarily high purity A very sensitive test for the purity of platinum is afforded by the measurement of its "fundamental coefficient"—that is, the mean change of resistance per degree Centigrade in the interval 0° to 100° C Some measurements of the fundamental coefficient of this recently produced platinum wire have shown values as high as 0.003922. The highest hitherto recorded value of this coefficient was 0.003917 This slight improvement in the performance of the resistance member of a precision electrical instrument is of great importance to the engineer who uses it and the designer who makes it.

Autojack That Works Like a Hydrostatic Press

THIS automobile jack is really nothing more than a miniature hydraulic press. Power and pressure are obtained in precisely the same way as in the press. The force exerted is communicated to the plunger by means of water forced into the cylinder By application of only the little finger, even, a considerable weight may be lifted



The hydrostatic jack

The Heavens in March, 1922

The American Association of Variable Star Observers; Its Work and Its Needs

By Professor Henry Norris Russell, Ph.D.

THE advancement of most of the sciences is made exclusively by men who have chosen this field for their profession. They may be, and usually are, teachers as well, or perhaps they will be able to utilize their abilities to financial advantage in the practice of their profession, as in engineering and medicine But, in almost all instances, no man can hope to add anything of consequence to the sum total of scientific knowledge which already lies within our grasp unless he has had an extensive and exacting technical training.

This rule, like many other good ones, has its exceptions. In some fields, even of science, the amateur still holds his own, and can make contributions which are useful, and at times important. The great examples of this at the present day are found in the realm of astronomy Although some branches of the science demand severe training, and mathematical ability beyond the average, even in order to understand the work of others, there are lines in which the man without such training may do valuable service, provided only he has love of the work, patience to continue in it, the use of a small telescope, and the simple knowledge which enables him to find the stars and interpret what he sees. Not many months ago we spoke of one such field of usefulness for amateurs—the discovery of comets, which now is seriously neglected.

The comet-seeker, however, may spend months, or even years, at the work before he is rewarded by a discovery To one type of mind the knowledge that such a discovery, when it comes, will give his name a permanent place in the annals of science is motive enough for the long search, but to another type work is more attractive which assures of securing results of scientific value for each night's work, even though they may not be spectacular, or afford an "undying name."

Such opportunities are found in the observation of variable stars. Many hundreds of stars are now known to vary in brightness, and every one of them deserves observation When we know what physical processes are going on—as in the case of the eclipsing variable like Algol—we can use the observations to find out various things of importance, such as the size, shape and brightness of the stars involved. In the more numerous cases—including most other types of variables—in which we are still uncertain or quite in the dark regarding what is really happening to cause the changes in brightness, observations are even more important, for it is only by collecting facts that we can obtain any rational basis for future theories, and only by studying all the available stars that we can come upon those which, by some peculiarity in their behavior, are especially suited to test our theories and lead us to a deeper understanding.

The isolated amateur, even if he has a good telescope of fair size, is at a serious disadvantage in undertaking such work. To identify the stars which he is to observe he needs star maps, and maps showing the telescopic stars are not cheap or easy to obtain. He will estimate the brightness of the stars which he is watching by comparison with other neighboring stars of constant brightness, but the measurement of the light of those stars is a hard task for the amateur. Moreover, after his work is done he may find that someone else has all the time been observing the same star, duplicating his work, while some other stars, perhaps of greater interest, have gone unwatched.

Organizing the Work

In order, therefore, that the work of amateur astronomers may attain its full value, some scheme of co-operation is necessary The first attempt at such cooperation was made in England by the British Astronomical Association. It was followed soon, and very successfully, in this country by the American Association of Variable Star Observers. The Association was launched in 1911, with only seven members, but has proved so useful and successful that its members now number nearly 300—mostly in the United States, but some in other countries all over the globe

Anyone who has a small telescope—three inches or more in aperture—and desires to observe variable stars, is cordially welcomed as a member The Association will supply him with detailed descriptions of the methods of observing which have been found most valuable, with blanks for recording his observations, and most important of all with photographic charts of the region near each variable star—charts on which are marked the variable, and a set of comparison stars. The magnitudes of these stars have been determined by observation at Harvard, and are marked on the chart.

In return, the amateur is requested to send a monthly report of his observations to the central office of the Association at Harvard, where they are collated and sent month by month to *Popular Astronomy* for publication. In this way each observer can check up his results with those of others, and see, too, what stars need more observations than they are getting During the past ten years the members of the Association have contributed more than 120,000 observations.

What Amateurs May Do

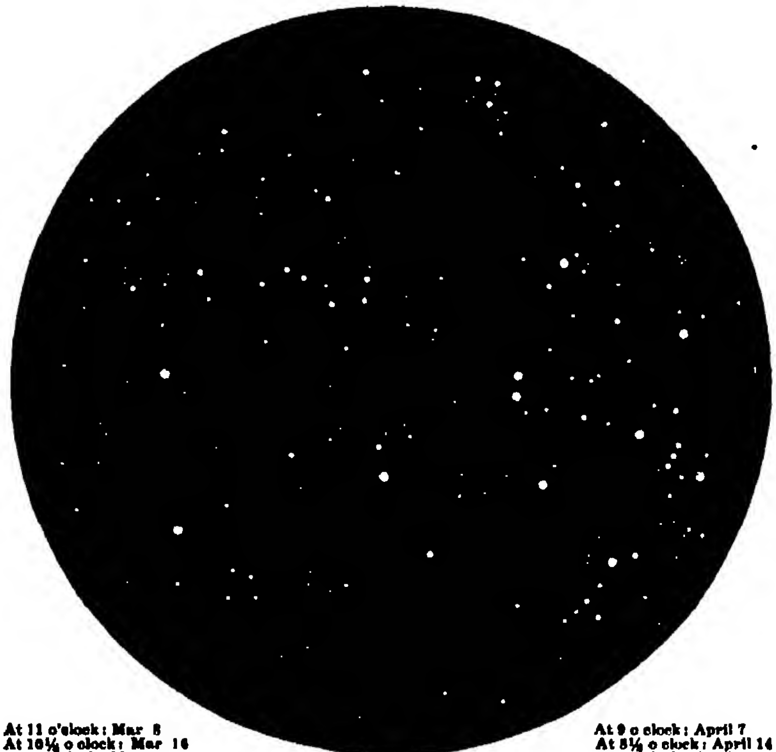
There is hardly any type of variable star upon which amateurs may not make valuable observations Even among the eclipsing variables, for which precise observations with large telescopes are most important, there are many whose periods are not yet known The watch on such stars, night after night, until they have been "caught faint" often enough to determine the true period, is most profitably made with a small telescope. Similar remarks might be made about the regular variables of short period, but the great field of the Association lies among the long period variables which form the majority of all known variable stars. For these objects, the estimates of brightness by an observer of a reasonable degree of practice are satisfactory for all present purposes, and they are so numerous that the professorial staff of the observatories of America would hardly have time to follow them all if they had little else to do. The splendid mass of observations which are now being secured by the association of amateurs affords by far the best base that has ever appeared for a study of the very interesting and difficult problem of the cause of the variation

Still more interesting are certain irregular variables for example, *ss Cygni*, a star which is usually of the twelfth magnitude, but brightens up almost overnight to the 9th at irregular intervals of about sixty days A close watch has been kept on this star for years, and on the two or three other stars which behave in the same way

Such a rapid outburst of light makes one think of the "new stars" or novæ. Is *ss Cygni* a sort of recurrent nova, undergoing the same sort of changes, to a less violent degree, and oftener? Our best hope of an answer would come through the spectroscope, but the star is so faint that the great Mount Wilson telescope alone could tackle it By mutual arrangement, last summer, the variable star observers agreed to telegraph to Mount Wilson when the sudden brightening of the star was observed, and thanks to this information, Adams secured spectra which, though very peculiar, showed a certain resemblance, in the presence of enormously widened lines, to those of novæ in certain stages.

But the work of the "A. A. V S. O" does not stop here Arrangements are sometimes made for the loan of telescopes, not employed at the time, to observers who will make good use of them Many observatories have a number of small telescopes which are lying idle, and have gladly lent these to amateurs whom they had reason to believe to be ready to use them in real astronomical work, and not for mere star-gazing A library of astronomical books is also maintained, from which members may borrow works which they may need

To extend these varied and very useful activities the Association is now seeking to raise an endowment. Rooms for the use of the Association and a dome in which to house the largest telescope that belongs to it will be provided at the Harvard Observatory—leaving the income of the endowment almost wholly "free," without "overhead," for the support of the present and projected research work of the Association. This plan promises so excellently that it appears quite proper to diverge for a moment from the usual policy of these columns, and suggest that any friends of astronomy who are able to aid in it, either by observations of their own or by financial aid, should communicate with the Secretary of the Society, Mr W T Olcott, of Norwich, Conn.



At 11 o'clock: Mar 8
At 10½ o clock: Mar. 16
At 10 o'clock: Mar 23

At 9 o clock: April 7
At 8½ o clock: April 14
At 8 o'clock: April 22

At 9½ o clock Mar 29

NIGHT SKY: MARCH AND APRIL

The Planets

Mercury is a morning star all this month, and is farthest from the sun on the 12th, when he is 27½° away Being to the south of the sun he does not rise so early as he would otherwise do, but even so he gets up an hour before the sun, and should be fairly easy to see.

Venus is an evening star, just past conjunction, and sets about 6 40 P M. in the middle of the month She is so bright that she should be easy to see in the twilight

Mars is in Scorpio, moving slowly eastward in the heavens approaching us, and growing brighter By the end of the month he is only eighty million miles away and looks as bright as Arcturus.

Jupiter is in Virgo, a little west of Spica, and comes to the meridian at 1 30 A M in the middle of the month Saturn, which is in the same constellation but about 10 degrees farther west, is in opposition on March 25th

Uranus is just past conjunction with the sun, and is invisible Neptune, on the contrary is well placed in Cancer, in R. A 9h 5m 33s., Dec plus 16° 47' on the 2nd, and 9h 8m 24s., plus 16° 50' on the 30th

The moon is in her first quarter at 2 P M on the 6th, full at 6 A.M. on the 13th, in her last quarter at 4 A M on the 20th and new at 8 A M on the 28th, during the eclipse She is nearest us on the 28th and farthest away on the 25th During the month she comes into conjunction with Neptune on the 10th, Saturn and Jupiter on the 14th, Mars on the 18th, Uranus and Mercury on the 26th, and Venus on the 29th. The conjunction with Jupiter is fairly close.

There is an annular eclipse of the sun on the 28th which just gets into the class of those visible in the United States. The northern limit of partial eclipse includes Florida and the West Indies and on the other side of the ocean, takes in nearly all of Europe

Recently Patented Inventions

Brief Descriptions of Recently Patented Mechanical and Electrical Devices, Tools, Farm Implements, Etc.

Pertaining to Aeronautics

AIRPLANE.—B B. WOOD, 1708 La Fond St, St. Paul, Minn The invention relates generally to an airplane designed to carry a large number of passengers and which is provided with planes constructed and arranged to form efficient sustaining means and which are adapted to form a parachute for retarding the fall of the air plane to the ground in the event of an accident, such as the failure of the motor to continue its operations. A further object is the provision of pontoons to permit of its functioning as a hydroplane.

FLYING MACHINE.—C. E. and W G HICKS, address Chas. E Hicks, Mechanicville, N Y The invention relates to a flying machine of the helicopter type, which shall present lifting surfaces capable of exerting a maximum pull with but a minimum effort. An object is to provide a device of this character in which the pull exerted by the lifting elements will be constant, irrespective of the speed with which the same is operated The machine comprises a plurality of lifting elements arranged in spaced relation to and above one another (See Fig. 1)

Pertaining to Apparel

CONVERTIBLE GARMENT —I WHEELER, 32 West 15th St., New York, N Y An object of the invention is to provide a convertible garment more especially designed for wear by children and arranged to combine bloomers, a waist and a dress to permit wearing the dress with or without the bloomers or the bloomers without the dress. Another object is to permit of conveniently opening the garment for sanitary purposes.

Chemical Processes

COMPOSITION OF MATTER.—M WEINBERG 48 Hawthorne St., Brooklyn, N Y This invention has particular reference to a composition of matter for use as a rust preventive. An object is to provide an economical, simple and efficient composition in the form of a paste which can be used when mixed with water, preferably as an antirust solution for metallic surfaces, especially cutlery The composition comprises ordinary soap, sodium carbonate, glycerin and formaldehyde.

EMBALMING PROCESS FOR DEODORIZING —T B BARNES, 24 W Sixteenth St, New York, N Y Among the objects of the invention is to provide a method the practice of which will result primarily in the destruction or neutralization of insanitary or offensive odors, and the process includes such treatment of the body as will tend to render it stable or in such state of preservation as to not give off odors subsequently

PROCESS OF TREATING AND RECOVERING FOR REUSE OILS RESINS GUMS ETC, WHICH HAVE BEEN HARDENED C LITTLETON c/o Special Process Co, Hopewell, Va The invention relates to the recovery and use of oils, and the like which have been used as paints or varnishes or which have been otherwise dried or hardened. The process consists of dissolving or suspending the hardened material in an alkaline solution and there treating it with active chlorin, and then exposing the treated material to a current of air This material may be ground up for reuse.

QUININ SILVER-PHOSPHATE COMPOSITION AND PROCESS OF MAKING SAME.—R. L CROWE, c/o University of Tennessee, Memphis, Tenn. The invention has reference to germicidal silver, and more particularly to a composition which contains phosphoric acid combined with silver and alkaloidal quinin. An object is to produce a germicidal silver salt which may be used instead of silver nitrate. The process comprises dissolving freshly precipitated silver phosphate in syrupy phosphoric acid and adding alkaloidal quinin to the solution to complete saturation

Electrical Devices

TELEPHONE ATTACHMENT —J P LEE, 104 Washington Ave, Pleasantville, N Y The invention relates to a telephone attachment by means of which it will be possible to prevent any sound from entering the transmitter mouthpiece when it is so desired, without the necessity of placing one's hand over the transmitter, and the device when applied virtually prevents the entrance of any dust, thus retaining the instrument in a thoroughly antiseptic condition

CABLE SECURING DEVICE PARTICULARLY APPLICABLE TO THE FIXATION OF ELECTRIC CABLES ON CARBON-BRUSHES.—E. GINDER, 12 Rue de Lorraine, Levallois Perret Seine, France. This invention has for its object a device for fixing an electric cable on a carbon brush, the device being combined in such manner as to insure a perfect contact and fixation whatever may be the heating to which the connection may be subjected. The loss by contact with this connection is reduced to a minimum, and it is not exposed to injury either by any oxidation or by heating of the carbon brush.

ELECTRICAL FUSE.—H. SNODGRASS, Box 135, 21 School Hill, Bisbee, Arizona. In general this invention comprises a cylindrical casing of insulating material which is split longitudinally and which has on each end the usual metallic cap which is likewise slit. Clamping means on each end which are easily operated hold the two split portions together The fuse link is held within the casing and when burned out is easily removable by releasing the clamping means and separating the casing. (See Fig. 2.)

GAS GENERATOR.—M. BOISEN, 1511 Camp St., Sandusky, Ohio. An object of this invention is to provide a construction and arrangement of apparatus for electrically decomposing water to generate oxygen and hydrogen and direct these gases through separate outlets to any desired containers or point of use The generator comprises a tank, cells in the tank, hollow metal electrodes in the cells, the cells having gas outlets in their upper ends.

ELECTROLYTIC CELL.—J CRANSTON and W D LE BAR, address John Cranston, Trenton, Mich. An object of the invention is the provision of a cell which is simple, compact and efficient, and is capable of ready assembly and disassembly. Another object resides in the provision of means whereby the anode structure can be adjusted relative to the other parts so that the functioning of the anodes can be considerably prolonged, and means whereby the chlorin, the alkaline liquor and the hydrogen gas evolved during the operation of the cell can be very readily collected.

FLASHLIGHT GENERATOR.—W W ANDERSON, Box 105, Michigamme, Mich This invention aims more particularly to provide a device in which the source of electrical energy is derived by a hand-driven generator, the construction being such that it is not necessary to continuously operate the mechanism to produce a steady stream of light. The device is provided with a plurality of flywheels associated with the armature to provide an even speed when operated. The invention is simple in construction and may be manufactured at a relatively small cost. (See Fig. 3.)

Of Interest to Farmers

CATTLE STANCHION —D B. COATES, Payette, Idaho. The purpose of this invention is to provide a stanchion of extremely simple, durable and inexpensive construction having a locking lever permanently carried by the stanchion and operable to automatically lock the stanchion in contracted position. The stanchion is supported for universal movement so as to conform to the movements of the animal.

QUEEN BEE REARING DEVICE.—W B. YATES, Ventura, California. The invention has for its object to provide mechanism especially adapted to facilitate manipulation in queen bee rearing to permit the various manipulations necessary in such rearing, without leaving the hive open and exposed to weather or robber bees. In the invention each cell is independently supported. When it is desired to examine a cell it is only necessary to lift the top from the hive and remove the cell required

PINK BOLL WEEVIL DESTROYER.—J M. Webb, Flat, Texas. The invention relates to a pink boll weevil and worm catcher and destroyer, and is particularly adapted for use in connection with the raising of cotton plants, so as to rid the plants of these injurious pests in a convenient and effective manner, the device being so constructed as to permit it to be readily applied to cultivators through the medium of the beams thereof.

SELF-FEEDER FOR HAY PRESSES AND THRESHERS —E. O STANCLIFF, R.F.D. No. 6, Bakersfield, Cal. The foremost object of the invention is to provide a self-acting feed mechanism either for hay presses or threshers, so arranged as to automatically take care of the material without supervision of an operator A further object is to provide a feeder embodying means for automatically regulating the feed, and periodically dividing the hay or other material being fed, so as to deliver uniform quantities.

CORN PLANTER.—E. A. GOLLE, Grand Beach, Mich. An object of this invention is to provide a corn planter in which the means for controlling the dropping of the seed can be operatively connected at will with a traction-operated member of the device, thereby causing seeds to be dropped when the device is drawn forwardly A further object is to provide means for controlling the dropping of the seed, means for making the seed rows, and means for covering the seed which has been dropped.

STUMP PULLER.—W. W BIRRELL, 2529 Grand Ave., Milwaukee, Wis. An object of the invention is to provide a device for pulling stumps which is so arranged as to permit of pulling a plurality of stumps at one time. A further object is to provide means by which the stumps are pulled from opposite directions, so that the stumps on one side afford an anchorage for pulling the stumps on the other side. A still further object is to provide a tractor with a plurality of drums for drawing in the cables which pull the stumps, each drum being independently controlled.

Of General Interest

TRUNK CONSTRUCTION —D. B. HART, 121 St. Nicholas Ave., New York, N Y The object of this invention is to provide a trunk of the sectional type especially adapted for use by traveling salesmen, the independent sections being capable of being nested and locked to each other, thus preventing their being separated and lost. A further object is to provide a trunk including adjustable means for connecting and locking any number or all of the sections together (See Fig. 4.)

SANITARY WARDROBE SHELF.—J FORESTER, 1967 Madison Ave., New York, N. Y Among the objects of the invention is to provide a shelf of such nature that there is no place for dust, dirt or vermin to accumulate and be held, to provide a shelf having attachment or hanging means of such nature as to be easily applied to the supporting walls to effectively support the shelf, and means for the attachment of an extension to the main part of the shelf so that the main and extension parts will be perfectly flush.

STAGE-COSTUME APPLIANCE. — H SKEEMKA, 258 W. 85th St., New York, N Y The aim of the invention is to provide a stage costume appliance by means of which novel and spectacular effects may be achieved. An object is to provide a device which shall be relatively simple and by means of which the costume may be caused to be manipulated to produce an illusion which shall be pleasing to the eye. A further object is to provide means for supporting the device in such manner that no discomfort will result to the wearer

COLLAPSIBLE SEAT FOR CHILDREN —W V HOLLEY, 108 Chambers St., New York, N Y An object of the invention is to provide a simple, strong and easily collapsed commode seat. A further object resides in the provision of a structure wherein in assembling the seat a minimum amount of time and labor is required, whereby the seat can be easily made ready for immediate use.

METHOD OF CONSTRUCTING REINFORCED CONCRETE STRUCTURES. —E. VAN BAVEGEM, Oostersele, Belgium. The invention relates to reinforced concrete

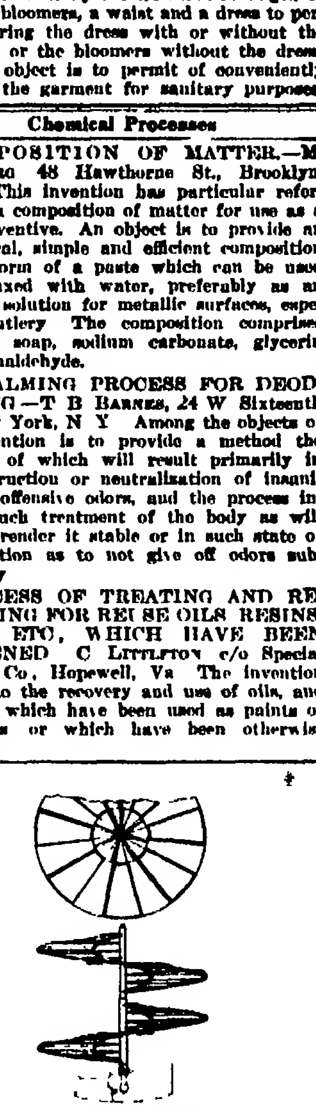


Fig. 1 The constant-lift helicopter, designed by C. E. and W G. Hicks

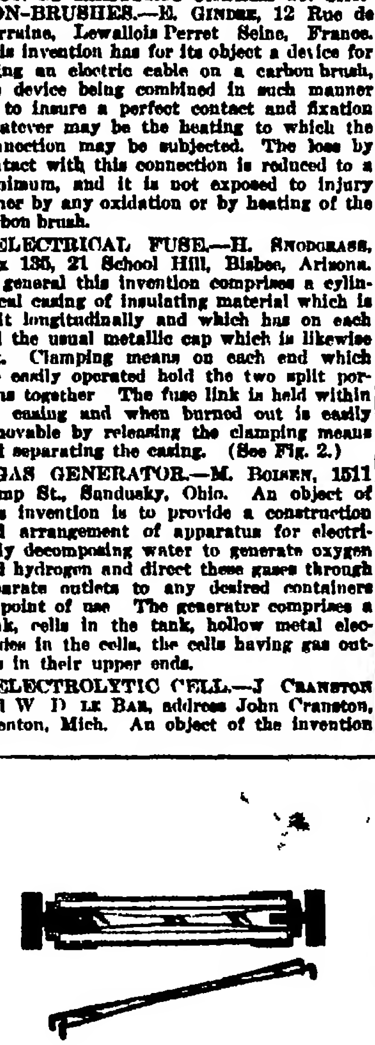


Fig. 2. Electric fuse with easily renewable fuse member, patented by H. Snodgrass

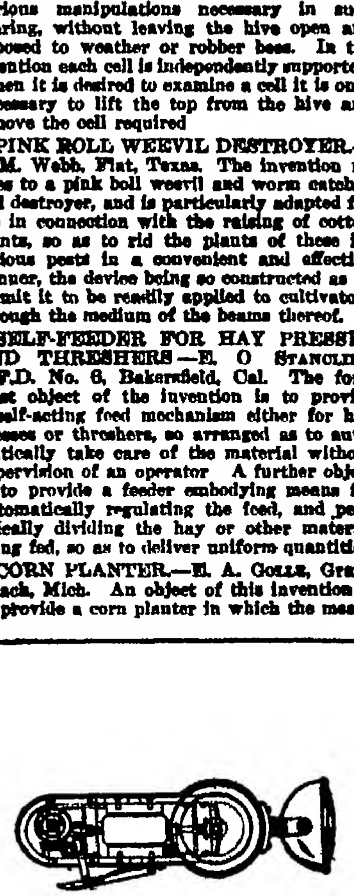


Fig. 3. Economy is the idea behind W. W. Anderson's flashlight generator

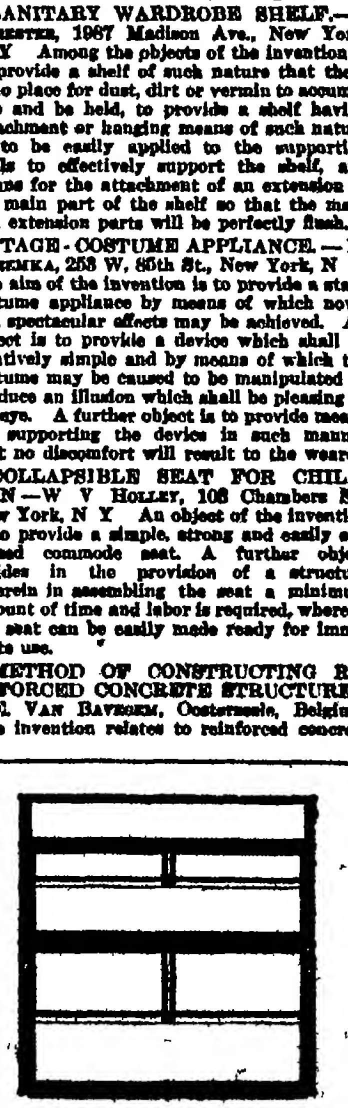


Fig. 4. The novel trunk construction invented by D. B. Hart

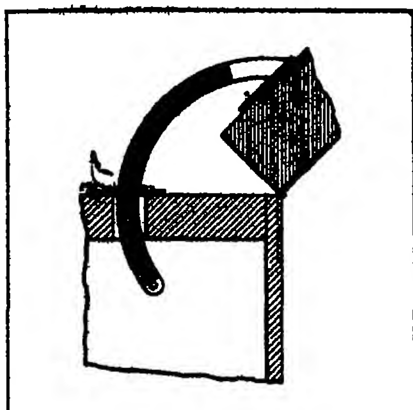


Fig. 5 Holder for hinged window frame, put out by W. L. Burtis

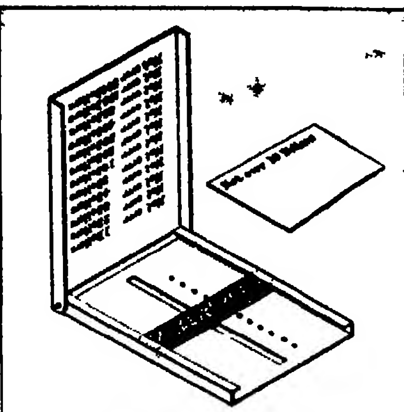


Fig 6 Pocket check protector devised by O K. Linscott

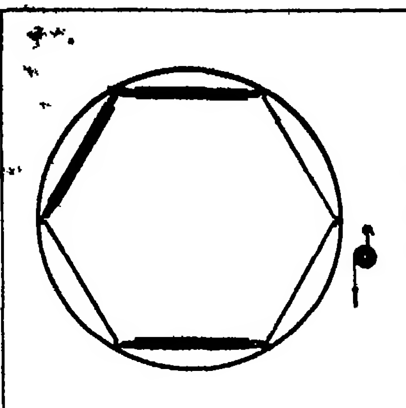


Fig. 7 Disappearing curtain for lampshade use, patented by H A Kurre

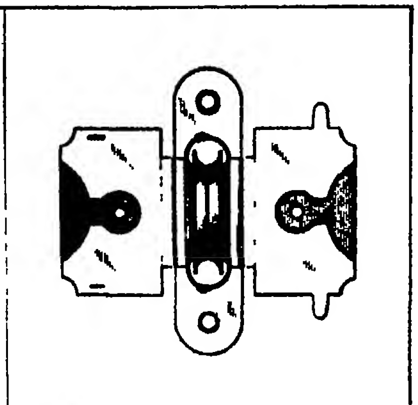


Fig 8. Housing and attaching flange for sash pulleys, designed by W F Krueger

structures in which hollow walls are molded complete in a horizontal position with window casement and door frames, and cornices where required The complete building forms thus a unitary structure made up of ready molded monoblock sections, and the labor of erection is made as simple as possible

CAMERA.—T Gallo, 244 E. 13th St., New York, N. Y This invention relates to a camera which will have as one of its objects the provision of a ground glass plate by means of which the camera may be focused accurately, whether a roll film or plate is intended to be used, without resorting to the necessity of removing the film. A further object is the construction of a camera which will be capable of receiving either roll film, plates or cut film at the option of the user.

POULTRY FEEDER.—C. J Pfeiffer, Box 54, R. F D No. 1, Calicoon, N Y The invention is particularly designed as a device for feeding grit or ground oyster shell, although it may be employed for feeding grain or similar food The principal object is to provide a feeder with means for sifting the contents of a gravity feed hopper whereby the dirt, husks or other foreign particles are eliminated during the feeding operation.

TOOTHBRUSH HOLDER. — C. B Baker, c/o Miss. Dental Association, Armory, Miss. The object is to provide a receptacle which receives the tooth brush and protects the same from contamination by dust, dirt or the like while exposing it to the advantageous action of light, which provides a separate compartment for each brush, and which is in all respects sanitary and hygienic, and may be readily attached to any convenient support.

FORM LIFTER.—L. M. Convery, c/o J M. Undergraff, 1620 Second Ave., Peoria, Ill. This invention has for its object to provide a device especially adapted for lifting and supporting concrete forms, used in building construction, wherein the lifter is adapted to be connected with the form and has means for engaging a supporting rod or pipe so arranged that the lifter carrying the form may be moved up the pipe and will hold the form in adjusted position

COIN HANDLING APPARATUS —S J Brunt, Disbursing Officer, U S. Naval Training Station, Hampton Roads, Va. One of the foremost objects of the invention is to provide a method of handling large quantities of coins, a preferably rectangular or square box being used to hold the coin, and being so arranged that stacks of coin can be readily shoved out for distribution. A further object is to provide a box, the lid of which is sealed and having the amount contained therein indicated in some convenient place, and the coins so arranged that the individual rows can be inspected in order that a balance may easily be calculated.

PIPE JOINT.—H. G. Plummer, 823 Security Bldg., Galveston, Texas. The invention relates particularly to joints of the ball and socket type adapted for use in dredge floating pipes. The purpose is to provide a joint which is flexible under any and all conditions, effectively lubricated, and one which successfully withstands all stresses to which it may be subjected.

RECEPTACLE AND CARRIER FOR EGGS.—R. M. Odell, Box 82, Leavenworth, Kansas. The primary object of the invention is to provide a receptacle capable of use with shipments of eggs in the ordinary egg case which will prevent breakage of eggs, which will provide for a free circulation of air in cold storage and which will allow of readily examining the eggs while in transit or storage A further object is the provision of a filler in the nature of a tray having a series of attached egg pockets, the tray being adapted to fit the ordinary egg case

PEN AND PENCIL CLIP —R. Moore, 354 Hunter St., Ossining New York The invention has for its object to provide a clip form mounted upon a pen or pencil for use in quickly and easily securing the same in the pocket of the user The clip detached from the pen or pencil can be applied to the edge of the pocket, and left there when it is desired to use the pencil without the clip

SPUR.—P M Kelly, Dalhart Texas. An important object of this invention is to provide means whereby the attaching buttons on a spur may be swingingly connected to the band of the spur in such manner that the same will lie flatly in contact with the ankle portion of the boot so as not to scrape or wear the boot. A further object is to provide means whereby the swinging button attached to the arm of the spur may be readily renewed

TEA OR COFFEE POT —R F Olsen, Box 1274, Spokane, Wash. The invention comprehends a coffee or tea pot which is provided with a pair of diametrically opposed handles and spouts, so that the same may be passed from one person to another without setting the device down, and the person passing the same can maintain a hold until the person receiving the same has tightly grasped it.

EGG CARTON —R. M Odell, Box 82, Leavenworth, Kan The present invention relates more particularly to devices for safely packaging eggs for transportation or parcel post service, the object being the provision of a device by means of which the eggs may be shipped without danger of breakage in separated cup-shaped cells, and which when disposed within a cover or the like forming a carton proper, will act as a brace to prevent collapsing. A further object is to provide a device in which air, heat, cold or moisture may be excluded from the package thus doing away with the necessity of cold storage

BAG —C. J Fresse, 547 Broad St, Elyria, Ohio. The invention has particular reference to a bag which is produced preferably from cheap material and which includes a closing flap with a handle associated with the flap for carrying the bag. The primary object is to improve the construction of such bags, especially the means for fastening or anchoring the handle.

BARREL PROTECTOR.—W. F Meek, c/o Tex Oil and Gas Co., Apartado 152, Tampico, Mexico. The aim of this invention is to provide a device particularly adapted for use in connection with barrels, and by means of which the barrel may be braced and generally strengthened to withstand the shocks incident to handling in transportation. An object is to provide a brace or protector which shall be of simple construction and permit of instantaneous application, and without adding to the space occupied by the barrel.

CASEMENT HOLDER.—W L. Burtis, 449 New Rochelle Ave., Bronxville, N Y This invention relates to means for securing a hinged window frame at any desired position of adjustment, an object being to provide a casement holder in the form of a curved bar having serrated surfaces, and provided with means for engaging the bar to secure the window against movement. A further object is to provide a device of this character which is simple and inexpensive, yet durable in use. (See Fig. 5.)

RANGE FINDER —L Ginzbourg 152 Chestnut St, Jersey City, N J The invention relates more particularly to a device especially adapted for finding the distance of objects in order that a camera may be properly focused The primary object is to provide a device which is small and therefore easily portable, and by which the distance between the camera and the object to be photographed may be ascertained with sufficient accuracy to enable sharp focusing of the picture.

PRICE TICKET HOLDER L and H Hopp, 230 West 17th St., New York N Y One of the principal objects of the invention is to provide a price ticket holder in which price indicating means may be retained against accidental displacement or movement of the holder thereby providing a holder in which the several elements are at all times in proper position A further object is to provide a holder especially adaptable for use with flexible and interchangeable price tickets.

POCKET CHECK PROTECTOR —O K. Linscott, Tekoa Wash The invention has reference more particularly to a small and compact device which may be carried upon the person so that it may be handy for use in preventing fraudulent alterations in bank checks and the like The device comprises a pair of plates the inner face of one plate having a series of fixed printing characters and the other plate having a movable inking device adapted to cooperate with the printing characters to reproduce any one of the series on a check when presented between the plates. (See Fig 6.)

DOMESTIC COOKING VESSEL —G W Watts 702 Central Ave Merchants Cafe, Hot Springs, Ark The object of the invention is to provide a domestic steam cooking vessel which is highly efficient in use in that it conveys the steam from the generator chamber to the container for the substance being cooked without exposing the steam to the possibility or danger of being condensed, and which delivers the steam to the bottom of the container whereby the steam rises upwardly through the substance to be cooked

CURTAIN FOR LAMPSHADES OR DOMES.—H A Kurre, 340 7th St Brooklyn, N Y The invention has for its object to provide a curtain designed for use in connection with lampshades or domes and arranged to permit the user to readily shade the eyes against direct rays of light emanating from the burning lamp. Another object is to provide a spring-controlled curtain which may be quickly attached and which is normally in inactive, out-of-sight position, but can readily be drawn into active position to form a shade. (See Fig 7)

Hardware and Tools

ADJUSTABLE BIT —T G Doyle 345 Hanover St, Fall River, Mass. An object is to provide a bit with an adjustable bar carrying the spur at the operating end of the bit and secured in its position of adjustment by means of the same screw which is utilized for securing the cutter plate at its proper adjustment. A further object is to provide a bit having removable spurs, one of said spurs constituting a portion of the cutting plate and the other removably clamped against the bit by means of the securing means of the cutting plate.

SAFETY DOOR FASTENING —J M. Reed, 19 Kossuth St., Brooklyn, N Y An object of the invention is to provide a construction which will not be in the way when not in use, but will effectively resist opening the door beyond a certain extent when in use, the idea being to produce a device which will take the place of the ordinary door chain, but which may be adjusted to lock the door in a partially open position

PULLEY CASING —W F Krueger, 2184 Canalport Ave, Chicago Ill This invention relates to a housing and attaching flange for sash pulleys The prime object is to simplify and cheapen the construction of sash pulleys to which end it is proposed to produce the housing and attaching flange of the pulley from a single sheet of material, the parts being so arranged that they may be stamped from the sheet in a single operation, and bent in such manner as to properly support the axle of the pulley for free rotation. (See Fig 8)

FISHING TOOL —C H Brown Box 772 Breckenridge, Texas This invention has for its object to provide a tool for finding and removing undesirable objects from wells as, for instance broken bits pieces of stone and the like, wherein a body is provided having a series of barbed holding rods normally extending below the body and resiliently supported to permit them to yield when directly engaging the article to support the same during removal

CURTAIN ROD —J B Akers 20 Camp St, Newark N J This invention relates to rods adapted to support curtains in juxtaposition to the window at the inside of the same being so mounted as to swing at right angles, or clear of the window in order to afford maximum ventilation and light in gress. The device is adjustable to windows of various widths and may be swung to permit of convenient cleaning of the window panes It may be easily mounted in position for use

Heating and Lighting

MERCURY VAPOR LAMP —M J Cornu, 28 Rue de Babylone Paris France This invention has in view more particularly a damper of the oscillations of the mercury an arc-striking device and various constructional forms of current supply arrangements. This lamp possesses the property of being able to strike its arc just as well by mere rocking as by the action of the expansion of the gas under the influence of the heating lamp

RELIEF VALVE.—H W Justus Napanoch N Y An object of this invention is to provide a valve which will permit the escape of air from a steam system, and will automatically close and prevent the escape of steam therefrom A further object is to provide a diaphragm controlled valve which may be readily applied to a steam system which will act quickly will be simple and readily accessible in case it should need repair

INDICATOR.—H A Soderberg 74 Bostwick Ave Jersey City, N J The invention has for its object to provide an indicating mechanism which will facilitate the application of a needle to a phonograph record in the dark, by providing a luminous indicator associated with the record and with the needle arm of the producer, which will make it possible to quickly apply a needle on the outside edge of the grooved playing surface of the record

OIL BURNER.—A A Lindley 1728 West Riverside Ave., Spokane, Wash The purpose of the invention is to provide a self-cleaning fuel oil burner for use in connection with hot water and steam furnaces or the like, and so constructed as to prevent

clogging, but provided with means for cleaning the same out with steam or hot water in case of necessity. The device is provided with means whereby the regulation is automatic according to the temperature of the heating plant. It also permits of the parts being easily cleaned and maintained in good order.

Machines and Mechanical Devices

ROCK DRILL SHARPENING DEVICE.—J. H. HINES, Sta. A, Box 134, Auburn, Calif. The invention relates to rock drill sharpening machines. The foremost object is to provide a machine having convertible mechanism thereon and operated preferably by compressed air for collaring a rock drill or for shaping and sharpening the cutting point. A further object is to provide an arrangement in the gripping jaws, enabling the reversal of the jaws for the purposes of collaring a drill in one position and sharpening the drill when in another position. (See Fig. 9.)

LINE MAKING ATTACHMENT FOR TYPEWRITING MACHINE.—R. G. PEREIRA, Box 927, Valparaiso, Chile. Among the objects of the invention is to provide a line making attachment arranged to permit the user to quickly and accurately produce horizontal or vertical lines or combinations of the same, such as are used in making out diagrams, invoices and other typewritten matter. Another object is to permit of easily applying the attachment to various types of typewriting machines.

PLUME WASHING MACHINE.—I. TESSA, 78 Jefferson St., Brooklyn, N. Y. An object of the invention is to provide a machine having facilities for having attached in definite positions upon a carrier a large number of pieces to be washed whereby the operation of the carrier and the units through a supply of water or other cleansing medium the plumes will be thoroughly saturated and subjected to auxiliary means in the nature of scrubbers or agitators.

COMBINED RECORDER AND REGISTER.—R. B. CORMANY and A. F. HERRING, Box 85, Rome, Ga. This invention relates more particularly to a combined recorder and register for use with fluid-dispensing mechanism. The object is to provide a device which will make a permanent record of the fluid dispensed with respect to both volume and frequency of the flow and will openly register the quantity of fluid dispensed and will secretly register the volume of flow.

PORTABLE DERRICK.—W. S. GARRETT, 321 W. Marshall St., Richmond, Va. One of the foremost objects of the invention is to provide a portable derrick which is capable of being easily operated. A further object is to provide a portable derrick in which the steering, propelling, turning, revolving and load lifting functions can be accomplished by one man and whereby the load can be readily dumped from the lifting cradle by operation from the platform of the derrick. (See Fig. 10.)

DRILLING MACHINE.—G. K. ATKINSON, c/o Aurora Tool Works, Aurora, Ind. The primary object of the invention is to provide a drilling machine in which all of the moving parts are inclosed, thus protecting them from dust, dirt and the like, and at the same time affording protection against injury to the operator. A further object is to construct the machine in such manner that all the parts are readily accessible.

MILK BOTTLE CAP TUBING MACHINE.—P. P. SIMMONS, Huntington, Ind. The invention relates to a machine which is adapted to be used in connection with a milk bottle cap-making machine for the purpose of receiving the caps and packing them into a tube or other container. A specific object is the provision of a machine embodying a pair of oppositely rotating parallel screws spaced apart so that the bottle caps can be dropped into the space between the screws, whereby the threads convey the caps through a guide, which directs them into the container in an even manner.

MIXER.—G. C. TRUSLOW, Draper, N. C. An object of the invention is to provide a time and labor saving mechanism for mixing different classes of fibers such as cotton and wool or fibers of various colors. A further object is to provide a mixer which will be simple and practical in construction, strong, durable and efficient in use and comparatively inexpensive to install and operate. The device includes means whereby an air current passes through a continually swinging distributing arm to carry the mixed material into a feed pipe. (See Fig. 11.)

LAWN MOWER ATTACHMENT.—W. I. BOLL, Platteville, Wis. An object of the invention is to provide a means for adjusting the roller of a lawn mower. The invention is particularly designed for that type of mower wherein the roller supports the blade carrying frame, and by adjusting the roller the blade may be brought into close proximity to the ground to cut the grass short. A further object is to provide an adjusting mechanism which may be readily employed on lawn mowers of the usual types now on the market.

Musical Devices

PHONOGRAPH RECORD CABINET.—J. HEITMAN, 2305½ First Ave., Seattle, Wash. The aim of this invention is to provide a record cabinet having simple means whereby a desired record may be projected to a position from where it may be entirely removed from the cabinet. A further object is to render the ejecting mechanism inoperative while one of the records is removed from the cabinet so as to prevent the removal of additional records until the record which has already been removed is replaced.

DRUM EAR.—O. MEYER, 913 N. State St., Chicago, Ill. An object of the invention is to provide a drum ear which has means for preventing the slipping of the same along the drum cords. A further object is to provide a device of this type which can be quickly adjusted and which will not "stick" nor cut the drum cord. The device is simple in construction and operation, practical, commercially and not likely to get out of order easily.

Prime Movers and Their Accessories

MANIFOLD.—H. W. ALLEN, 98 Safford St., Fresno, Calif. The invention has for its object to provide a device of the character specified especially adapted for use with carburetors for heating the vaporizing tube by means of exhaust gases, and for heating the mixture before it is delivered to the engine. The manifold not only heats the fuel before it enters the carburetor but also heats the mixture as it passes from the carburetor.

AUTOMOBILE FUEL CUT-OFF.—E. S. KING, c/o H. P. King Electrical & Machine Works, Osgood, Ind. The invention relates to internal combustion engines. The object is to provide a cut-off which is controlled by the pressure in the lubricating system of the engine which is effective to cut off the supply of fuel to the engine when the pressure in the lubricating system falls below the point at which a complete circulation is insured or dangerously exceeds the point of safe operation.

COMBINED INTAKE AND EXHAUST MANIFOLD.—G. F. CLARK, c/o Sherman Theater, Des Moines, Iowa. The present invention relates generally to gaseous fuel vaporizers and more particularly to a combined intake and exhaust manifold structure the arrangement of which is such that gaseous fuel for engine consumption will be intimately fixed and vaporized in its passage to the engine by the influence of the hot exhaust gases.

Railways and Their Accessories

LOCOMOTIVE JOURNAL LUBRICATOR.—J. G. B. PROUDFOOT, R. No. 5, Grafton, W. Va. A purpose of the invention is the provision of a lubricator which is adjustable to permit of its adaptation to journals and axles of various sizes, and which is so constructed as to render it easy of access. A further object is to provide a lubricator which may be readily removed and replaced from a journal box, and which insures reliable lubrication of the journal to prevent its becoming heated.

Pertaining to Recreation

TOY AIRPLANE.—L. J. PERKINS, Room 9 Beach Block, Lewiston, Idaho. An important object of the invention is to provide a toy airplane which may be thrown into the air for a substantial distance and which is caused to move in a circle or spiral path when descending. A further object is to provide a toy airplane having a pair of ballast weights which are automatically actuated when the airplane reaches the limit of its upward movement so as to operate the vertical and horizontal rudders. (See Fig. 12.)

GAME APPARATUS.—G. H. BUGENHAGEN, Welnrebe Bldg., Minot, N. D. An object is to provide a game similar to checkers in which the continuity of moving successively from square to square is interrupted by the provision of a central passage zone in the form of a cross, whereby greater mental effort is required in playing the game, consequently more enjoyment is derived therefrom.

GAME.—J. JOHNSON, Box 583, Menlo Park, Cal. The particular object of the invention is to combine the indoor game of billiards with the outdoor game of croquet or roque in an outdoor game which will necessitate but minimum space and which may be utilized beneath awnings, tents or other covering. The prime object is the provision of a game board which will render possible the playing of a game embodying the above characteristics.

PLEASURE RAILWAY.—H. F. RIEHL, 1448 East Nineteenth St., Brooklyn, N. Y. The object of the invention is to provide a railway for use in pleasure resorts, parks, exhibition grounds and the like and arranged to take up comparatively little space. Another object is to provide for safety of the passengers even should the car truck become disconnected from the car body containing the passengers.

Pertaining to Vehicles

DEMOUNTABLE WHEEL.—H. E. HOLLETT, Otisville, N. Y. The object of the invention is to provide a demountable wheel structure comprising a non-circular hub section carried by the axle, an abutment flange at its inner side, a reduced axial extension projecting from the opposite side thereof a rotary non-circular member carried by the extension and capable of circumferential adjustment thereon to bring respectively the same into and out of register with the hub section.

VEHICLE WORK STAND.—G. W. ANDERSON, 248 Magnolia Ave., Elizabeth, N. J. This device is particularly designed for supporting motor vehicles in elevated relation with respect to the floor of a garage for effecting repairs. Among the objects is to provide a work stand which is equipped with means for retaining the vehicle in place thereon, said means being rendered active automatically by the running of the vehicle thereupon. The stand is also adjustable to accommodate vehicles of various sizes and types.

HAND WHEEL.—H. W. DOVER, Holywood, St. James, Northampton, England. The invention relates to hand wheels such as are employed for steering motor vehicles, for operating stop cocks, controlling aircraft, motor boats, gun mechanism, and other purposes. A special object is to provide an arm for a hand wheel bent from a sheet metal blank, the marginal portion of said blank being inturned and forming a diaphragm within the arm.

AUXILIARY TRACTION DEVICE FOR MOTOR VEHICLES.—A. H. GEDDES, 288 Clermont Ave., Brooklyn, N. Y. The prime object of the invention is to provide an auxiliary traction device by providing means for transmitting power from ditched or mired driving wheels to the remaining wheels. A further object is to provide means for retaining the steering knuckle spindles in alinement to insure an even traction on the driven wheels. The device may be applied to practically any standard make of motor vehicle and set up for use in a minimum of time.

TRACTOR SAFETY DEVICE.—A. GUIGNARD and F. ROSIGER, Flood River, Oregon. Among the objects of the invention is to provide an attachment for tractors in the form of a hand lever which is controlled by the operator so that in the event of the operator being thrown from the seat of the tractor the supply of gas will be either entirely or partially shut off to stop the tractor.

Designs

DESIGN FOR A GAME BOARD.—R. H. COTTER, 859 St. John's Place, Brooklyn, New York.

DESIGN FOR A BRACKET FOR THE HEAD RING OF AN ELECTRIC LIGHT FIXTURE.—H. SHLAMOWITZ, 1409 Forty-first St., Brooklyn, N. Y.

DESIGN FOR STATUETTE.—HELEN TYLER, address c/o Ho Thoi Sales Co., 102 West 40th St., New York, N. Y.

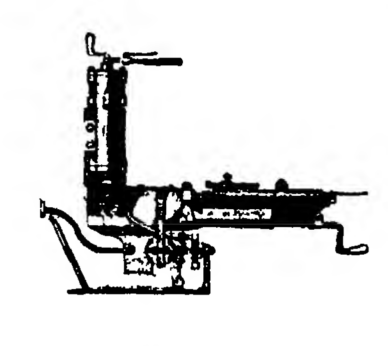


Fig. 9. Rock-drill sharpening device of unusual utility, the invention of J. H. Hines

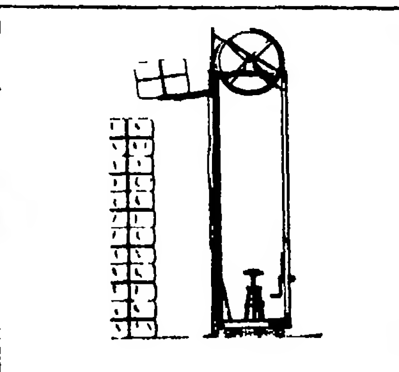


Fig. 10. Portable derrick for one-man operation, patented by W. S. Garrett

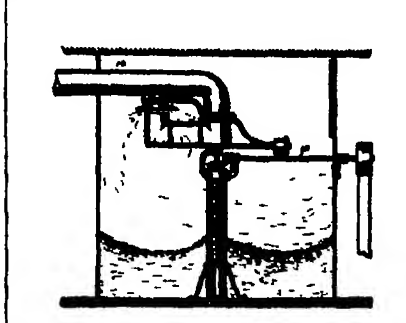


Fig. 11. Mixing device for cotton, wool and other vari-colored fibers, invented by G. C. Truslow

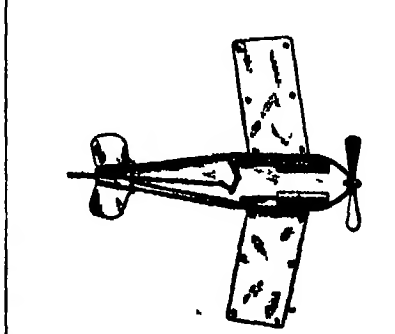


Fig. 12. Toy airplane of novel design, put out by L. J. Perkins

Miscellaneous Notes

Taxing Altitude.—The higher above the pavement Parisians live the higher taxes they pay. In place of the unpopular levy on pianos the stair carpets and elevators of apartment houses will be taxed. The more stair carpet or elevator you use the more you pay.

An Inland Lighthouse.—The lighthouse once off Atlantic City well out to sea is now 500 yards inland from the board walk and surrounded by paved streets and apartment houses. In 50 years the shifting sands have added millions of dollars worth of land to the northern end of the island.

A City of Storks.—In Angora, the capital of Nationalist Turkey, storks may be seen everywhere. One pair nest on the top of the column reared by the Romans in honor of Augustus, others on the roof of the Parliament building, several pairs make their home on the Hotel Hurist. Boys are brought up to let them alone. Indeed Anatolia is a birds' paradise, for the Turks never shoot them or destroy their nests.

War Horses Are Honored.—Of 243,135 horses and mules with the American forces during the war, 68,682 perished. A bronze tablet in memory of the services of these our four-footed defenders, was recently unveiled in the State War and Navy Building. It was presented by Dr. Stillman, president of the American Humane Association, and was received on behalf of the Government by Major General Holbrook, Chief of Cavalry.

Heavy Demands on Hickory.—Hickory, with its unrivaled strength, elasticity and resiliency, is used for tool handles, for the spokes of automobile wheels, for golf clubs, and for many other purposes. There is increasingly keen competition among the industries for this wood although there are still 15,784,000,000 board feet standing throughout the country. Manufacturers have to go farther for their supply, and really select stock is already very hard to obtain in the required quantities.

Shipping Cases for Rubber.—A new case for shipping sheet rubber has been introduced into Singapore shipping circles by an American firm. These reach local exporters in the form of sheets made of 100 per cent fiber, the riveting, packing and wiring being done by the shippers. The thinness of the sheets enables the cases built from them to hold from 12 to 25 per cent more weight of rubber than the old wooden boxes, and the new construction is practically unbreakable, very cleanly, and waterproof.

A New Stage Effect.—A Russian widow, Mme. Ivan Boutkovsky, has devised an ingenious scheme for multiple scenery whereby two scenes are painted upon one canvas. Colored lights are thrown upon this drop-scene which bring out certain colors while concealing others so that with the same stage setting either a landscape or an interior may immediately be brought into view. Playing several acts with one set of scenery is an idea that should appeal strongly to producers, both as a novelty and from an economical point of view.

Revolutionizing the Orchestra.—Leo Sir, an aged violin maker of Marmande, France, has perfected instruments that may revolutionize the orchestra. At present we use four violin type instruments ranging from the soprano violin to the bass viol. M. Sir provides two super-sopranos, a mezzo soprano slightly above the present alto, a barritone just below the tenor, and a sub bass. The newly-organized orchestra has been tried out at the Montmartre Theater and critics declare that the possibilities of interpretation are wonderfully increased.

A Shrewd Scheme.—Missoula, Montana, has a wide-awake chamber of commerce. It decided that the mail-order catalog while highly diverting to the population also diverted much business from local firms. Why not destroy all the catalogs in town? Now Missoula has, too, a movie theater and a genius, name unknown. His plan was for the theater to advertise that mail-order catalogs would be accepted in lieu of the usual admission price, and prizes given for the oldest, the most used, and the newest catalogs. The scheme worked to a charm, and its success was celebrated by a bonfire fed by the Chicago publications. We should like to record that the mail-order houses came back with a retort as ingenious as the challenge, but the best thing they could think of was to complain to the Federal Trade Commission, alleging unfair practice "unreasonably burdening commerce."

Science Notes

A Digest of Everything of General Interest Appearing in Current Literature

Inbreeding of Species.—In an experiment with 600 white rats belonging to the sixteenth to the twenty fifth generations of brothers and sisters from the same litter, it was found, says *Science*, that close inbreeding produced no deterioration.

Sawdust as Stock-Food.—From an experiment station in Wisconsin comes the report that after a long-continued diet, consisting of one-fourth part of white-pine sawdust in their ration, cows showed no visible change in their weight or milk production

Spiritualistic Mania.—From Southern Bavaria comes the report of an entire family of 11 members going insane through spiritualistic experiments. The neighbors found them, after destroying their furniture, about to offer up an infant as a sacrifice to the "spirit of pure light."

Turpentining the Pine.—Successive seasons of turpentining cause no lowering in strength or resin content of pine trees, states the Forest Products Laboratory of Wisconsin The crude turpentine is the result of wound stimulus, and comes only from living cells in the sap wood region of the tap bore The heart wood, which consists of dead cells, contains no sap.

Prehistoric Freight.—When the cargo of a ship was unloaded recently at Portland, Oregon, it was discovered that a certain portion, which was supposed to consist of walrus tusks, proved to be the ivory tusks of the mastodon Crafty Siberian natives had substituted these for the walrus ivory which was ordered The cheaters, however, cheated themselves, for in spite of its great age the substitute was well preserved, and the large size of the tusks consequently made them more valuable.

Crabs vs. Concrete.—In an effort to foil the shipworm, a wooden bridge crossing Boca Ciega Bay, Fla., was replaced by one of concrete Certain marine crabs, however, peculiar to that region, selected this bridge as their own, tunneling and boring into the adamantine material with ease. These crustaceans are known locally as stone crabs, and they are equipped with enormous, heavily armed claws. With the aid of these powerful tools they have succeeded in reducing portions of the concrete pilings to pulverized chalk.

The Fertile Aphis.—The report of the Smithsonian Institution just issued, gives an account of the hop aphis, in which the amazing fecundity of these minute insects is shown. According to the author, the mother aphis produces thirteen generations in a year As each generation contains on an average of one hundred individuals, it was revealed that her progeny—barring destruction from the attacks of enemies and other natural causes—would number well into ten sextillion aphides annually

Tree Growth.—With the aid of a newly designed dendrograph, some remarkable features relating to the growth of trees was determined These included such phenomena as actual daily shrinkage and expansion of trunk circumference, a restricted period of growth (not over three months' duration), and a non rhythmic growth dependent solely on food supply, temperature and moisture. It was also found that the inchoate foliage and the elongation of branches may occur weeks before the trunks begin to enlarge.

Moths and Mimicry.—In some large quarries in Argentina it has been observed that a certain species of night flying moths frequents these places during the day to rest. The moths lie flat against the rocks, which they match perfectly in color, and are practically invisible This instance is peculiar by reason of the fact that these quarries contain a colored stone which is unknown elsewhere, and the further fact that it is less than a hundred years since the quarries were opened.

Ancient Bedfellows.—Although the ancestry of the bedbug appears to be unknown, it has been ascertained that its probable companionship with man began at a very early period. This probability is based largely on the habits of a closely related species which infests the nests of certain birds. It seems that along with man's evolution from a creature of arboreal habits to one of more refined tastes, the bedbug, on its part, lost no time in adapting itself to the changing conditions.

How Old Is Ann?—A belated report *from the South African Museum states that* a gigantic turtle captured in the year 1884 died at that place a few months ago. At the time this animal was captured it was full grown, and its death gave rise to much speculation as to the longevity of these creatures, for, as yet, nothing is definitely known about their natural term of life When the turtle was acquired by the museum it was named Peter One day Peter laid an egg. A hurried consultation of the museum principals took place The result was a blushing decision to give Peter the effeminate but not inappropriate name of Ann

Squirrels and Toadstools.—An English naturalist reports that squirrels are fond of fungoid plants. His observation of the animals in their natural haunts showed that they ate with evident relish the Fly Agaric, a mushroom deadly poisonous to man. It was noted, though, that they ate only the stalks of the plants, leaving the umbrella, or cap, untouched This raises the question as to whether the factor of safety lies in the immunity of the animal or in the fact that the poisonous substance is concentrated in the rejected parts. If the latter be true, it reveals an interesting feature of the instinctive discrimination of these animals.

Corn with a Story.—A variety of corn grains was found in the mortuary urns of prehistoric graves, recently unearthed in Tennessee The only other cereal of its kind —a type between true flint and popcorn—occurs in the West Indies. This is taken by the Bureau of Ethnology as proof of intercommunication between the ancient peoples of North America and those islands, if not evidence that within the time of man the West Indies were a continuous part of the North American mainland. As the locality in which these graves have been found becomes more fully searched, it is possible that other sustaining evidence in this connection will be found.

Sex Determination.—By starving male newts (Triton alpestris) at the time spermatogenesis is most active, it has been found that the animals remain in a neuter condition. Then, again, by feeding them plentifully throughout the winter, during which period these animals are neuters by nature, they were found to assume female coloration and other feminine characteristics in the following spring. The most curious transformation, however, was discovered when they were dissected. The fatty tissues of the reproductive organs contained an ovary and young ovocytes, such as would be found in a recently metamorphosed female, together with well-developed oviducts.

A New New Zealand.—The gradual disappearance of the native races of New Zealand, and the ever-increasing European population is not the only great change taking place in that antipodal country As a result of the competition with imported species which have returned to a feral life, the lower animals are also fast giving ground. Nor is this change confined to the animal kingdom. More than eleven millions of trees of various kinds have been imported from the United States and elsewhere by reason of their superiority over the slow-growing native species; and these hardy forests of temperate origin bid fair, in time, to crowd out their sub-tropical rivals.

Longevity of Nutgrass Nuts.—There are tales of the sprouting of grass nuts that have been buried for 30 years. Government weed specialists believe they have an authentic case of such nuts being in the ground for eight years without losing their viability. To settle the question four galvanized-iron cans about two feet square and four feet deep, without bottoms, have been sunk into the soil at the Arlington farm near Washington, each can holding 250 pounds of soil well filled with the grass nuts, and each is covered against light. The cans will be opened, one by one, in 1923, 1926, 1931, and 1936, and if the nuts prove to be as tenacious of life as has been supposed, adequate means of extermination will be sought.

Civil Engineering Notes

A Motor-Boat Non-Stop Run of 6527 miles, which is said to be the longest on record, is reported by *Engineering* as having just been accomplished by the new Pacific Steam Navigation Company motor-boat "Lobos" of 9000 tons. Having left Liverpool on October 20th, the "Lobos" arrived at Bahia Blanca on November 20th, without once having stopped her engines.

Another Bascule Collapse is reported from Grays Harbor, Wash. The bridge which had a span of 110 feet and a 16-foot roadway, was wrecked recently by rolling over backward. A new set of operating gear was being tested and was not handled very carefully. The pavement on the bridge was worn to such an extent that the counterweight was too heavy. While the bridge was being opened a gust of wind caught it and it was blown right over backward into the water.

A Valveless, Gearless Engine, intended ultimately for automobile use, is being brought to the bench test stage in Manchester, England. In a very general way it may be said that the cylinders are so arranged, in multiples of three, that ports between them open and close in a fashion which permits each piston, on the return stroke of its two-stroke cycle, to compress its own charge and to drive a charge into the combustion chamber of the adjoining cylinder.

Indian Hydro Projects.—Eleven sites in the Travancore State have been examined with a view to hydroelectric undertakings, says *Engineering*. As regards the Kallar scheme, the proposal is to construct a masonry dam to impound water in a lake of four square miles, with a fall of nearly 1000 feet. The Government of Bengal has appointed an expert committee to carry out a hydroelectric survey of the province. The survey is to be confined in the first instance to the Hill Tippera area round Comilla and Chittagong.

Electrification in Spain.—A development recently put under way includes about 40 miles of single track line comprising a link between the mining region and the northern seaboard, through a mountainous region with many tunnels, considerable grades, and severe climatic conditions. The locomotives will be arranged for regenerative braking, and will operate at 3000 volts. Their speed at continuous rating is to be 45 kilometers per hour. The contract has been awarded, and covers one of the largest European electrification operations now under way.

A New Water-Works Hazard.—Crawfish, according to the *Engineering News Record*, threatened to destroy a canal bank on the Cape Fear River by tunneling into the bank and causing it to leak. Sheet piling did not cure the trouble, as the fish worked round the ends or beneath the piling so rows of auger holes were made in the bank. The holes were filled with chloride of lime and small sticks of dynamite exploded in them. Other holes were charged in the same way with common salt and the fish were presumably exterminated, as the leaks stopped.

Carrier Current Control of trains on electric railroads is suggested as a present possibility by experiments and tests made recently at Schenectady. The demonstration was designed primarily to show the applicability of the system to the expediting of electric train operation. It was developed particularly to afford an effective means of communication between the head and rear ends of long freight trains. Experience on the St. Paul's electrified sections shows that it is also adapted to communicating ahead of trains stalled by a faulty block, and straightening out the tangle with a minimum of delay.

Shanghai Harbor.—The report of the International Board, which has been considering the question of the improvement of Shanghai harbor, recommends the dredging of a channel, 600 feet long and 30 feet deep in the south channel of the Yangtse estuary, the elimination of the private ownership of wharves, the entire harbor being placed under the International Harbor Commission, the construction of public quays and moorings and also of a commercial dock of the open type and mail steamer accommodation. In this connection it is proposed to build immediately a 600-foot wharf and 2500 feet of berthing suitably equipped. The estimated expenditure on immediate requirements is 10,750,000 Shanghai taels.

Radio Notes

A Review and Commentary on the Progress in This Branch of Rapid Communication

The Chicago Broadcasting Station, operated by the Westinghouse organization and known as KYW, is heard regularly at such distant points as Lutz, Fla., Austin, Texas, Woburn, Mass., as well as at other distant points. The normal radius of transmit is about 750 miles. The equipment is similar to that used by the Newark and Pittsburgh stations, operating on 360 meters wave length and using 500 watts.

Radio Equipment of Huge Airplane.—There has been installed on one of the huge "Goliath biplanes engaged in the Paris-London aerial service a combined radio telephone and telegraph equipment of 85 watts antenna output, with a sending range of about 180 miles at 900 meters' wave length. The complete radio equipment, according to *Radioelectricite*, weighs only 125 pounds. An air propeller-driven generator for six volts and 700 volts and a 6-volt storage battery supply the necessary current. A 3-bulb amplifier is used for receiving on all wave lengths between 300 meters and 1000 meters.

British Vacuum Tubes.—Our British friends have evidently made up their mind not to fall behind in the matter of vacuum tubes. Thus their vacuum tube offerings range all the way from small receiving tubes to large tubes of 500-watt capacity. The latest tube, or valve, as they call them in England, is the Mullard ORA. The plate voltage of this tube is given as 30, and the filament voltage as 3.6 to 4 volts. The base of this tube is of the four-prong type. This tube is said to combine efficiently the qualities of a rectifier and an amplifier. Thus it becomes possible to carry only one tube in stock for all purposes.

The Brown Microphone Relay is a modification of the type used by the Royal Air Force and the Admiralty. It is enclosed in a polished teak case. On the radio side it has a resistance of 4000 ohms, and has a transformer mounted on a separate base with condenser, suitable for telephones of 120 ohms resistance. This is a highly efficient instrument, especially for the amplification of feeble signals, and enables the operator to dispense with the use of vacuum tube amplifiers. Whereas the current consumed with tube amplifiers is considerable, the current required for the microphone relay is minute, being approximately only 25 milliamperes supplied from a 6-volt dry battery.

The Amateur Transatlantic Tests.—Amateur operators sent radio messages from this country to Scotland during the recent past which were reported as strong and steady by the representative of the American Radio Relay League, which was in Scotland to receive the signals. The transmitting sets were limited to a rating of 1 kw maximum and to a wave length of 200 meters. This is in contrast with the commercial transmitters rated at 100 kw to 1000 kw, or over using long wave lengths. According to reports received by the Radio Corporation of America, all of the successful senders employed vacuum tube transmitters. Nearly all the messages received in Scotland were sent from New England and New York State.

Loud-Speakers.—It is interesting to note how many devices are being introduced for service as loud-speakers in connection with the receiving of broadcasted music. One of the new devices is a simple horn provided with two arms that terminate in soft rubber caps. The ordinary pair of telephone receivers clamps right over the two arms, so that the sound must then pass up through and be amplified by the horn. Another device takes a single receiver, which is placed in the base. Several receivers are provided with special coupling members so that they may be fastened to the usual phonograph tone arm, for amplifying the sound. There can be no doubt that broadcasted music is at its best when it is heard through some form of loud-speaker.

Radio Telephony for Moving Trains.—France has recently been carrying out experiments on the Nord Railway with regard to the employment of radio telephony between moving trains and between a moving train and a fixed point. Radio antennae were fixed on to a railway coach, and a compartment of the same coach was fitted as a transmitting and receiving station. Between two telegraph poles by the side of the line horizontal antennae were fixed at a given point. As soon as the train left Paris a radio conversation was begun between the train and the radio station at the Gare du Nord, and was continued until the train left Creil, 34 miles distant. Without any modification of the wave length, the voice remained, it is stated, equally clear whatever the distance of the train from Paris, and whatever its speed, which was at times 50 miles an hour. Experiments are to be tried between Paris and Calais.

A Suggestion to Vacuum Tube Makers.—While there was nothing better, the usual vacuum tube was considered just about ideal for the general run of vacuum tube work. However, since special tubes have appeared on the market—or at least are supposed to be on the market, for it is almost impossible to obtain them at this writing—it now occurs to the usual radio enthusiast that the regular run of vacuum tubes consume too much filament current. Consider, for instance, a detector and two-stage amplifier. That makes three tubes. Each tube draws somewhat over one ampere, so that three tubes draw well over three amperes. Such a heavy current consumption renders quite out of the question the use of a dry battery. Then again, when a storage battery is used it has to be frequently recharged. In either event it seems to most of us that the current consumption is entirely too great. So it is indeed welcome news to learn of the new tubes coming along, which are going to operate on a single dry cell with a current consumption of one-quarter ampere. This is certainly a move in the right direction.

Reduction of Aerial Losses.—The difficulties to be overcome in raising the efficiency of high frequency generating plants are apparent upon very little consideration, but even so, it will come as a surprise to many to learn that of the high frequency energy generated and supplied to the aerial, as little as 10 per cent is radiated. There is an obvious field for investigation here, suggests *The Electrician*. In a recent paper by Mr. Eckersley, read before the Wireless Section of the Institution of Electrical Engineers, an account is given of work carried out in 1920 for the Marconi Company, in which the ground under the aerial was covered with a wire network and thus screened from the electrical field. As a result the losses were reduced four times. This is obviously a most important claim, and we can only regret that the discussion which took place, and which was maintained with a warmth that augurs well for the future of the Wireless Section, did not supply some of the omissions from which the paper suffers. It is of interest to know what is the precise effect upon the propagation of signals when no ground connection is used.

Radio vs. Audio Frequency Amplification.—More and more attention is being paid to radio frequency amplification, although audio frequency continues to predominate. The difference between these two methods is that radio frequency amplification consists of building up the intercepted radio energy before impressing it on the detector which in turn makes this energy capable of actuating a telephone or other device. Audio frequency, on the other hand, is used to build up the audible frequency current issuing from the detector. Now, in that many types of detectors only begin to function when the intercepted wave strength has reached a critical point, it stands to reason that very weak waves will not be detected and no amount of audio frequency amplification can help matters, since there is nothing to amplify. On the other hand, even with extremely weak signals it becomes possible to pass them through one or more radio frequency amplifiers to be built up before being introduced to the detector. Then, if desired, the output of the detector can be passed through several stages of amplification, so as to obtain maximum audibility.

Mechanical Engineering Notes

The Chip Wringer.—Under this very clever designation there appears a centrifugal extractor designed to separate from metallic chips and shavings the oil which adheres so tenaciously to such material After loading the separator with chips, a few turns of the basket, in one instance pour out no less than six gallons of high grade oil ready for use. It is to be doubted whether chips from all sources would assay so high in oil, but they always carry some, and it should always be profitable to recover this material.

Small Coil Springs, according to *The Practical Engineer*, may be tempered in a wood burning furnace, by being first exposed to the same, and then quenched in a mixture of ten quarts rosin, twelve quarts tallow, and a barrel of fish oil. More tallow should be added if the springs break after tempering, but if the break is due only to brittleness and not to hardness, a six inch ball of yellow beeswax should be added The springs can be drawn to a reddish purple by being laid on a frame with horizontal radial arms mounted on a vertical rod Held on this star-shaped contrivance, they should be lowered into a crucible of molten lead until drawn to the color desired

Blow-Pipe Hazards.—That there is a fire-hazard connected with the blow pipe is obvious, but the best precautions are not so plain It is not the pipe itself generally placed on a bench covered with a piece of sheet iron, that constitutes the danger, but rather the proximity of soldering fluxes and similar materials. Blow pipes should be mounted on an iron table with a dished top and this in turn should be mounted on a sheet iron base or on flag stones The table should be isolated from inflammable materials. It can conveniently carry a small vice and anvil, which is often useful in blow pipe operations, especially in electrical shops where many soldered connections have to be made

Machine Hammering with a "human stroke' is the interesting idea behind a recently developed rivetting hammer for small machine work Instead of carrying the hammer in the more usual drop-head the machine works 'just like a man ' The hammer head is at the end of a hickory helve just like the hammer we used to use back on the farm The handle end of this helve is fixed to a cam control and it is claimed that "the adaptation of the elastic stroke characteristic of the human arm and the old fashioned hammer has developed a resilient blow which coaxes metal into the desired shape with remarkable precision and speed —yet which kneads into the rivet stronger physical properties than have heretofore been possible Also a speeding up of some 20 per cent is claimed for the average job

New Uses for Rubber.—Among the many prize winning suggestions brought out by the offer of the Rubber Growers Association, the following are of interest liquid rubber incorporated with paint or other composition for preservation of wood and metals against the action of the sea, and in the prevention of fouling of ships bottoms. In paint for general decorative and preservative purposes For automobile curtains, tops and mud guards. The incorporation of rubber with cement for building purposes. The use of rubber as a heat retaining covering for hot water cisterns. For the construction of sea buoys and floats. In the construction of ship and wharf fenders. As filet for pattern making As caps for the ends of ladders to prevent slipping For rough surfacing cement. For covering door handles. In composition with certain lubricants.

Automatic Electrode Feed.—There has recently been placed on the market a semi automatic arc-welding lead, which may be attached to the standard automatic arc welder retaining the continuous welding feature of the latter while permitting the operator to direct the arc as required by the conditions of the work. The new device consists of a welding tool to be held by the operator which acts as a guide for the electrode wire In the handle of this tool is provided a switch for operating the control on the panel of the automatic welder Attached to the welding tool is a length of flexible steel tubing with an adapter at the other end for attaching it to the automatic welding lead By means of this attachment the operator can work on products where the seam to be welded is of very irregular contour, or on large jobs where the clamping and travel mechanism for full automatic welding could be complicated and costly

Patents and Trade-Marks

General Principles, Current Comment, and Interesting Decisions

Trade-Mark "Cedar" Descriptive.—The Commissioner of Patents has recently decided that the word "Cedar" as a trade-mark for polish for hardwood floors, wood work, furniture, etc., is descriptive (ex parte Channel Chemical Company, 293 O G 877). Incidental to this decision it was held that the use of the trade marks 'O-Cedar' and 'Cedarine" did not constitute a trade-mark use of the word 'Cedar" and that an applicant can not mutilate his mark to convert it into a descriptive mark and register it. It seems that the applicant attempting to register the word "Cedar" claims use thereof as early as 1886, basing this claim of use upon the actual use of the trade mark "O-Cedar' since 1907, and the use of the trade-mark 'Cedarine, which the applicant purchased in 1917, for dating back the alleged use of the word 'Cedar" to 1880.

The Lampert Bill.—Not only those engaged in the practice of patent law will be glad to learn that the Lampert Bill, providing for an adequate increase in the salaries of the Patent Office personnel has finally been passed by the House of Representatives, but as well all to whom patents and patent rights and the proper protection of inventions are directly or indirectly of importance The passage of this bill marks a distinct advance in the measures which have been undertaken to relieve the congested condition of the Patent Office, and it is to be hoped that the Senate will act promptly and likewise pass the bill The SCIENTIFIC AMERICAN does not hesitate to urge upon its readers to do everything possible to further the complete enactment of this law and to see that it receives favorable consideration at the hands of the members of the Senate

Patent Assignment Must Be in Writing.—A patent right is an intangible right of property, which nevertheless can be transferred from one to another as can any other personal property, but the law has clearly defined what means are necessary to effect such a transfer The United States District Court of Delaware has again pointed out (Mineral Separation, Ltd., et al vs. Miami Copper Co 275 F 572) that under the Revised Statutes, Section 4898 an assignment of a patent may be made by a written instrument only and though no particular form of words is essential yet to constitute an assignment the instrument must be substantially a transfer actual or constructive, with the clear intent at the time to part with the legal interest in whole or in part in the thing transferred and with full knowledge of the rights so transferred and an instrument which does not purport to transfer any present interest in an existing patent or in one for which an application is pending is not an assignment within the Statute

Application of Prior Art in Patent Suit.—Judge Anderson in writing the decision of the Circuit Court of Appeals of the First Circuit in a recent suit on the Eibel patent No 845,222 (Minnesota & Ontario Paper Company vs. Eibel Process Company, 274 F 548) gave a most scholarly discussion of certain processes of the paper-making art, particularly those involving the use of Fourdrinier machines which for generations have been the best known and most commonly used paper making machines. In deciding that the Eibel patent was invalid and was not infringed the Court reiterated the principle of patent law that a patent on a mere difference in degree in the use of a principle shown in the prior art, is invalid. Furthermore the court held that the principle of patent law by virtue of which a patentee is entitled to all the uses known and unknown of which his invention is capable, and gives to him the benefit of all the advantages of his invention which he did not discover, likewise applies to prior art uses and that in interpreting the prior art with a view to determining its bearing on the patent in suit, such prior art uses, although unknown at the time of the creation of the prior art patents, were pertinent.

Manufacturing Under Canadian Patents.—It is very important that Canadian patentees comply strictly with the provisions of the Canadian Patent Act with reference to the manufacture of patented inventions, for the general war extension of manufacturing time provided by the recent amendment expired on January 10th, 1922. In most cases it is advisable for patentees, on the issue of their Canadian patents, to consider the matter of having their patents ordered subject to the grant of licenses. When a Canadian patent is not ordered subject to the grant of licenses, the manufacture in Canada should be commenced within two years of the grant of the Canadian patent, unless an extension of manufacturing time is secured before the expiration of the said two years. Extensions of manufacturing time can be secured in such cases only where, in an affidavit, the patentee is able to set forth facts which will show that it would be an unusual hardship to compel him to manufacture within the two years. In cases where a Canadian patent is ordered subject to the grant of licenses, the patentee is not required to manufacture in Canada within a stated time in order to preserve his rights. Of course, should a license be granted the patentee will receive a reasonable royalty

Assignability of Trade-Marks. — A trade mark can not be assigned or its use licensed except as an incident to a transfer of the business or property in connection with which it has been used This is likewise true of a registered trade-mark, and Section 10 of the Trade-Mark Laws specifically so provides. The courts have repeatedly affirmed the correctness of the foregoing doctrine In Dietz vs. Horton, 170 F 865 it was held that a trade mark can not be assigned except as incident to the sale of the business and good will in connection with which it has been used or as an incident to the sale of the premises where the article has been made and has acquired a special reputation in connection with such place In Bulte vs. Igleheart Bros., 137 F 492, the court said 'A trade-mark is analogous to the good will of a business. Whoever heard of a good will being sold to one while the original owner continues the business as before? The good will is inseparable from the business itself So likewise is a trade-mark or a trade-name that gives assurance to a purchaser that the article upon which is stamped the trade mark or trade-name is the genuine production of the manufacturer to whom the trade-name or trade-mark points by association as the maker of the article Therefore it is that it is a necessary qualification to the assignability of a trade-mark that there goes with it the transfer of the business and good will of the owner of the symbol"

Names of Patented Articles.—Upon the expiration of a patent on an article of merchandise any trade-mark or trade-name that has been associated with the article in the sale thereof during the life of the patent becomes public property This doctrine is clearly expressed in Singer Mfg Co vs. June Mfg Co. 163 U S 169 where the Court, speaking by Mr Justice White, said "The result, then of the American, the English and the French doctrine universally upheld is this, that where during the life of a monopoly created by a patent, a name, whether it be arbitrary or be that of the inventor has become by his consent, either expressed or tacit, the identifying and generic name of the thing patented, this name passes to the public with the cessation of the monopoly which the patent created. Where another avails himself of this public dedication to make the machine and use the generic designation, he can do so in all forms with the fullest liberty, by affixing such name to the machines, by referring to it in advertisements, and by other means, subject, however, to the condition that the name must be so used as not to deprive others of their rights or to deceive the public, and, therefore, that the name must be accompanied with such indications that the thing manufactured is the work of the one making it, as will unmistakably inform the public of that fact." The doctrine of the above-quoted Singer case has been repeatedly upheld in subsequent decision bearing on this question.

Electrical Notes

Summaries and Excerpts from Current Periodicals

Using a Monkey Wrench to Connect Electric Cables.—Instead of solder, the modern tendency with regard to electric cable connections is to use a monkey wrench In other words, special connectors are being used which grip the cable ends firmly yet require only the application of a monkey wrench. Thus in a certain bit of work the old method would take two hours, while with the new connectors the cables can be connected in 15 minutes.

Awards of Potts and Cresson Medals.—The Franklin Institute, Philadelphia, acting through its Committee on Science and the Arts, recently awarded its Elliot Cresson gold medal to Dr Byron E. Eldred of New York City for his low expansion leading-in wire for incandescent lamps. At the same meeting the Institute awarded to Alfred O Tate of Cranston, R. I, its Howard N Potts gold medal for his electrolytic process and waterproofing textile fabrics.

The Morris Liebman Prize, the cash award made each year by the Institute of Radio Engineers to that member of the Institute who is considered to have made the most important contribution to radio art during the preceding twelve months, has been awarded to R. H Heising of the engineering laboratory of the Western Electric Company "for his analysis of vacuum tube action and his research work on modulation systems."

Edison Medal for 1921.—In recognition of his work in demonstrating that it was possible to transmit an electric current of 1,000,000 volts, the American Institute of Electrical Engineers has awarded the Edison Medal for 1921 to Cummings C Chesney, manager of the Pittsfield works of the General Electric Company Under Mr Chesney's direction electrical engineers developed the first revolving field type alternators installed in systems using 40,000 to 60,000 volts. He also developed commercial apparatus for service up to 220,000 volts, culminating in the last successful transmission of 1,000,000 volts.

Electric Conversion of Fodder.—A large Swiss company has acquired the patents of a new method to conserve vegetable fodder in silos. At the bottom of the silo is placed a large metallic electrode, upon which freshly cut grass, clover, corn, beet leaves, etc., are piled to the desired height, a metallic cover serving as upper electrode. Between these two electrodes a low voltage alternating current of from 200 volts to 500 volts is applied for a few days or nights, which kills all bacteria either directly by the current or by the developed heat. The conservation of 10 tons of fodder requires between 130 kilowatt hours and 200 kilowatt hours. Several years of actual trial have proved this method to be far superior to any other means of keeping fodder in silos without previous drying

The Small Power Plant for the Village.—According to *Electrical Review*, there are 125,929 towns and villages in the United States having a population under 1000 inhabitants. A large proportion of these communities are entirely without electric service and without prospects that central stations will be extended to give them service. To the end of overcoming this condition, an American machinery manufacturer has designed two standard sizes of 110-volt gasoline-engine driven generating plants complete, rated at 5 kilowatts and 15 kilowatts, respectively. The 15-kilowatt unit, supplemented by batteries, will successfully serve up to 50 average village buildings, including stores, churches, garages, etc. The sets are self-contained and consist of four-cylinder four-cycle engines directed connected to generators mounted on rugged cast-iron base plates.

A Vacuum Set for Panama.—There has been installed at Almirante, Panama, a 2-kw radio tube transmitter. The set consists essentially of equipment designed to supply direct current at 12,000 volts for the plate supply of the radiotron tubes, and for converting this power into radio frequency Power is supplied to the transmitter at 440 volts, single phase, 60 cycles, and stepped up to high voltage by means of a transformer, the output of which is fed into the rectifying system. The rectifying system consists of two kw kenotron tubes which supply 12,500 volts direct current to the plate circuits of the radiotron generators. The radio frequency power is generated by a system consisting of two 1 kw radiotrons with the necessary grid and plate coils, together with an antenna loading coil While it can not be predicted exactly what the range of this set will be, it is expected that it will equal if not exceed the range of a 50-kw spark transmitter As an example of its initial effectiveness, the set is now carrying on reliable and most satisfactory communication from Almirante, Panama, to New Orleans La, not only at night but during the daylight period as well

How the Submarine Cable Acts.—A number of interesting conclusions are drawn from the study of submarine cable transmission made by John R. Carson and J J Gilbert and reported by them in the *Journal* of the Franklin Institute The general conclusions are as follows (1) Contrary to usual assumption, the sea return' impedance is by no means negligible (2) the armor wires which surround the cable and which are necessary for mechanical protection have a very pronounced effect on the impedance of the sea return and even at moderate frequencies may become the controlling factor, (3) the rapid increase in the impedance of the armor wires with frequency and their pronounced and even controlling effect on transmission make a thorough going study of their role in the electric system a matter of first-class importance, (4) at relatively high frequencies the return impedance, and hence the attenuation and distortion, may be very greatly decreased by a correctly designed thin metallic sheath concentric with and in electrical contact with the armor wires.

Harnessing Wind Power.—A new attempt to make use of the winds has now appeared in the form of a combined wind mill, generator and storage battery outfit designed to transform the energy of all winds into electrical energy, store it in the storage battery, and have it transformed into useful work about the farm as required A 1 kilowatt generator is mounted on the main casting at the top of the tower and geared directly to the shaft of a 14 foot steel wind wheel. The gear bearings are mounted on roller bearings. The entire reduction gearing runs in an oil bath This generator which is of the 32 volt type, is a compound machine, differentially wound and gives a constant voltage characteristic over a speed variation ranging from 750 to 2500 r p.m The armature is carried on ball bearings which are packed in grease and will operate for one year without attention The storage battery is of the 32 volt type with a capacity of 280 ampere-hours. It is estimated that this is sufficient to operate the lights on an average farm for eleven successive days without recharging The battery can be charged at wind velocities varying from 8 to 30 miles per hour

A High-Speed Monorail System.—Between the twin cities of Barmen and Elberfeld in Germany there has been in successful operation for about 20 years a monorail overhead trolley system traveling at the rather high average speed of 20 miles an hour, according to *Electrical World*. The author of a somewhat visionary paper under notice gives a very elaborate and detailed description of a similar monorail road capable of traveling 200 miles an hour, and intended to connect Paris with Nice, a distance of 600 miles, to be traversed in three hours. Instead of using a solid girder construction to support the single running rail, Mr Mahl has chosen a rail held by a catenary cable suspension system. There is one driving wheel provided for each yard of length of the vehicle Each of these driving wheels has an inbuilt gearless 40-kw motor weighing about 1200 pounds. The complete car would weigh about 2800 pounds per yard, including passengers. To increase the adhesion of the wheels a magnetising winding is embedded in the outer part of the wheels. Steel towers, weighing each about 15,000 pounds, are supposed to be erected every 50 yards on the level and every 30 yards on grades. Six steel cables two inches in diameter support the rail.

Notes and Queries

The Notes and Queries column is maintained for the benefit of our readers who desire information on subjects germane to the scope of the paper, together with technical formulas and similar information. Matters requiring profound research or searches in a library cannot be undertaken. In connection with Notes and Queries proper, we maintain a "Service Bureau," which is able, in nearly all cases, to supply addresses of manufacturers whose articles have sufficient novelty and merit to be illustrated in the news pages of this periodical. Correspondents are requested to write their inquiries in all cases, making the subject of the letter entirely separate from the correspondence relating to patents, subscription, books, etc. This will greatly facilitate the answering of these questions, which in many cases have to be referred to experts. The full name and address should always be given. Our full "Hints to Correspondents" will be gladly mailed on request. All letters are answered by mail and only a very few of them can be printed in the limited space at our disposal.

(14392) J. P. D. asks how to "spot" tobacco leaf. A. We thought that there was no demand for a spotted leaf which was once so popular, but this may answer. Finely powdered ammonium carbonate, 2 av. oz.; solution of hydrogen peroxide, 16 fl. oz. Place the ammonium carbonate in a shallow dish, and pour upon it the hydrogen peroxide solution; effect a solution of the salt by stirring, and by the use of a small whisk-broom scatter the mixture upon the leaf, and let dry. Care must be taken that the hydrogen peroxide solution is of full strength.

(14393) H. B. says: I wish to prepare blue roses and preserve them as long as possible. You published a formula a number of years ago. A. We did. The SCIENTIFIC AMERICAN published a recipe for blue roses which are simply white roses whose stems have been submerged in the following solution: Water, 100 c.c.; aniline methyline dye, 2 grams; potassium nitrate, 2 grams. This color scheme representing a little less than 1/4 pt. of water and a little over 1/4 oz. each of aniline dye and saltpeter, is worth trying for the sake of novelty. You can preserve them by any one of the following formulas for a longer time than usual. The usual method of preserving cut flowers in a condition of freshness is to dissolve small amounts of ammonium chloride, potassium nitrate, sodium carbonate or camphor in the water into which the stems are inserted. The presence of one or the other of these drugs keeps the flowers from losing their turgidity, by stimulating the cells to action and by opposing germ growth. Flowers that have already wilted are said to quickly revive if the stems are inserted in a weak camphor water. Dr. Dixon states that tincture of nux vomica added to the water in which cut flowers are kept exercises a stimulant effect upon the flowers. The chrysanthemums on which he tried it held their freshness for an unusually long time.

(14394) J. B. C. asks for a formula for a good whitewash. A. There is none better than what is known as Government white wash." It is or was, used by the U. S. Government for painting lighthouses, and it effectually prevents moisture from striking through. Take of fresh Rosendale, or other good cement, 3 parts, and of clean, fine sand, 1 part, mix with fresh water thoroughly. This gives a gray or granite color, dark or light, according to the color of the cement. If brick color is desired, add enough Venetian red to the mixture to produce the color. If a very light color is desired, lime may be used with the cement and sand. Care must be taken to have all the ingredients well mixed together. In applying the wash the wall must be wet with clean fresh water, then follow immediately with the cement wash. This prevents the bricks from absorbing the water from the wash too rapidly, and gives time for the cement to set. The wash must be well stirred during the application. The mixture is to be made as thick as can be applied conveniently with a whitewash brush. It is admirably suited for brickwork fences, etc., but it can not be used to advantage over paint whitewash.

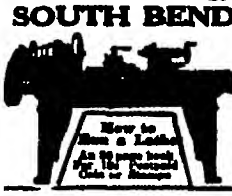
(14395) E. P. P. says: I occasionally want to make scented fish bait, prepared bait is so expensive. A. For moistening the bait, we need according to the *Pharmaceutische Rundschau*, the following preparations: (1) Peruvian balsam, 1, oil of mirbane (nitrobenzol), 1, anhydrous alcohol, 4. (2) Musk, 05, civet, .25, Peruvian balsam, 4; oil of aniseed, 1.5. (3) Extract of fresh "broad bean" leaves, 10 to 150, mixed with 10 of nitric ether, and 1 drop of volatile animal oil. (4) Especially for trout: civet with redwood oil.

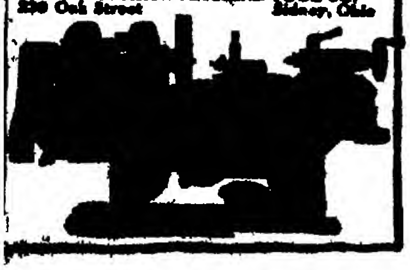
(14396) A. D. W. says: Can you give me some of the principal dates connected with the crossing of the Alps by various means of transportation? A. The Alps were crossed by Hannibal, 217 B. C.; by Domans 154 B. C., by Napoleon, May, 1800. Mont Cenis tunnel through the Alps commenced 1857, completed Dec. 25, 1870. St. Gothard tunnel commenced 1872, completed Feb. 29, 1880. Simplon tunnel completed Feb. 24 1905. First flight by aeronaut over the Alps, September, 1910.

(14397) P. W. R. asks how the inflammability of benzine can be reduced. A. Brodtmann says that he prepared mixtures of benzine and carbon tetrachloride in various proportions of volume, and found that a mixture of 7 volumes of tetrachloride and 3 volumes of benzine was still inflammable upon the approach of a match. The liquid burned with a strongly shooting flame under development of hydrochloric acid fumes. Only when the proportion reached that of 9 parts of tetrachloride to 1 part of benzine did the liquid require heating to inflame, but the flame soon became extinguished by itself. Benzine can be gelatinized as follows: Boiling water, 4 oz., cocoanut-oil soap, 4 dr. Dissolve, and when cool add ether and ammonia water, each 2 dr., glycerine, 1 dr. Mix the two solutions, and to 10 drops of the mixture in a bottle add about 1/2 dr. of benzine, and shake until it gelatinizes. More benzine is gradually added, with constant shaking, until the mixture soon assumes the appearance of boiled starch.

(14398) A. W. P. asks: Can you tell me what metal or substance is the clearest conductor of sound? For example, what metal or substance will, if tapped or struck sharply on one end (assuming it to be in the form of a rod) reproduce the sound most clearly on the opposite extremity? A. Probably aluminum is the most sonorous metal, and will reproduce the tone most clearly when a bar is struck on one end. It will vibrate for a long time and gives a very beautiful tone. Perhaps silver would be a close second to aluminum in this respect.

(14399) R. S. J. asks: Can you furnish me a formula for determining the relative humidity in per cent, as taken from the dry and wet bulb thermometers? We have in our plant a humidity dryer equipped with these instruments, but have no means of checking the relative humidity. For instance, if the wet bulb reads 90, and the dry bulb 130 degrees Fahrenheit, what formula would be used to determine the humidity? A. You will find in the Smithsonian Meteorological Tables, Fourth Revised Edition, 1918, the instructions on pages lvii lx the reduction of observations of the Psychrometer, or wet and dry bulb thermometers, but the accompanying tables, pages 171 185, do not carry the air temperature, dry bulb, above 120 degrees Fahrenheit, which is sufficient for the work of the Weather Bureau but not for your drying room. We would suggest a reference to the Bureau of Standards, Washington, D. C., for additional data. The formulas are quite complicated. You will first find the dew point and then the relative humidity by the methods indicated. Poynting and Thomson's Physics, volume, Heat, page 211, at bottom, has this statement, "At the best the instrument is not very exact. Its indications vary with its situation and the exposure to the wind, and it is best to use a simple formula and be content with an approximation to the truth." Following this advice you might apply to the Weather Bureau for Tables of Dew Point and Relative Humidity, which will answer the purpose and be as nearly correct as those which are employed by the Bureau in its work. Poynting and Thomson, as quoted above, give a simple formula, but all formulas require tables for obtaining vapor tensions and dew points at all temperatures, and some require also the barometer reading, so that without tables the humidity is not determined. For this reason a table giving dew point and relative humidity direct is the best way of obtaining the humidity





Winged Surveyors

(Continued from page 160)

to the wind, for a round trip, when the air blows from any direction, takes longer than in still air

Next comes the job of developing. The negative turns out all right. As each length is fixed it is put in a stationary tub and water kept running therein.

The next day each negative is numbered, the negatives are cut apart and each is put in a numbered envelope We make a print of each negative, being careful to get them the same tone as nearly as possible. More than one print from the same negative is required to keep this even tone

The biggest part of the job remains the assembling of the mosaic. The mosaic if assembled as a whole would be about 50x90 inches, which would be rather unhandy to handle and copy, for we plan to copy it photographically on large-sized negatives, 20x24 inches. We therefore plan to make the mosaic in two sections the adjoining sides of each section extending some three inches into the area covered by the other sections. This means some additional prints.

First, the area covered by each negative is plotted on the Geological map and the plotted rectangle given the same number as the negative. We have obtained data from surveys and large scale to give us the distances between some 12 points and their locations that can be identified on the photographs. These are for our control and will increase the accuracy of the mosaic.

A piece of compo board about 4x5 feet is put on the top of a table and on this compo board are located the control plants that lie in the section Distances are laid out at the average scale of the photographs For example, we place the photographs lying between points 1 and 2, the picture of 1 directly over the plotted position of 1 Then trimming and matching the pictures as closely as possible, we find that the picture of number 2 is ¼ inch short of the plotted number 2. The distance is about 2½ miles, or about 15 inches at the scale of 1/10000 This seems fair enough, for we believe that when wet with the stickum stuff this ¼ inch can be obtained If the distance is beyond the stretchability of the prints, we can adjust this difference by distributing that ¼ inch in the five or six intervening overlaps. But it is surprising how such errors can be adjusted by stretching and contracting the dampened prints. Nearly three weeks are required in making this assembly of prints and our bird's-eye view is complete

We had built a special 20x24 camera with a glass back against which 20x24 cut film could be pressed that could be used to copy We, of course, could copy to various scales, but at first wanted only 1/10000 for the whole island So our mosaics were carried to the camera and photographed It required 11 exposures So now to assemble a mosaic of Staten Island, we need only to paste down 10 prints, and that is lots easier than pasting down 170 prints, a sort of quantity results, you see

Now what have we?

It is a mosaic of Staten Island, an aerial survey It contains detail that no old-fashioned survey can record Even individual trees and bushes. Taking the pains we have taken in the photographing and assembly, we find by checking against some 20 known distances that it is safe in feeling sure that the scale does not vary more than one per cent from that stated as being the scale.

It is a picture of Staten Island, very good to look at, too And so much to be seen The more you look the more you see. When you first look at a vertical photograph, of course it interests you because it is something different and strange After looking at this mosaic for months, working over it for weeks and used to looking at vertical photographs, something new is always being found. Mrs. Smith's washing can be seen hanging on the line, so you know Mrs. Smith's wash day even if you don't know Mrs. Smith.

Interpretation of vertical photographs is a new art. During the war the French had perhaps a half dozen men who were rated as supreme in this sort of work And it is a safe bet that they are still finding things they never saw before. Development of aerial photography is now an educational campaign

People must learn to interpret such pictures to learn the use to themselves in their own special line of work. Railroad men municipal authorities, engineers and lumbermen will all have specialists who have become expert in seeing what they want to learn in a vertical aerial photograph.

Radio for Everybody

(Continued from page 168)

other station is to be installed in St. Paul, another in Oklahoma City, another in Denver Then there are stations which operate more or less regularly, scattered throughout the country Among these is 2XK, in New York City, operated by Lawrence Cockaday, 2XP, operated by Louis G Pacent at Winfield, Long Island, 8KK, operated by Frank Conrad at Pittsburgh, Pa., and a score of others. Union College, at Schenectady, N Y., is also operating a radio-phone transmitter The Western Electric Company has been operating a radio-phone transmitter off and on at its laboratory in New York City During one of the tests a 500-watt transmitter was employed, yet the steamer "Col. E. E Drake" intercepted the radio-phone conversation at a point 1000 miles west of San Francisco—something like a distance of 4000 miles The usual wave length of the Western Electric radio-phone transmitter is 450 meters.

Various colleges and other institutions have inaugurated radio-phone services. Typical of this class of broadcasting stations is the University of Wisconsin The physics department of the University has installed a radio telephone transmitter which covers a distance of 60 miles in broad daylight, and many times that distance at night and under ideal conditions. We might add here that radio waves carry farther at night than during the day, and better in winter than in summer The University is supplying a complete radio-phone service made up of weather forecasts market reports, concerts, news, and so on and is even going one step further by supplying all the necessary information and data for the construction of receiving equipment. A special code has been arranged, together with special mimeographed forms, so that the farmer, following the radio-phone reports can jot down the information in certain places on the mimeographed form and in that manner considerable time is saved Thus when the farmer hears "AC," the section marked "AC" on his mimeographed form informs him that the figures called off stand for "Hogs Estimated receipts for today" And so it goes.

At the Other End of the Invisible Line

Appreciating the real value of radio broadcasting, the leaders in many different lines of endeavor have and are freely giving their services evening after evening The greatest singers are going before the radio transmitter in order that they may entertain tens of thousands of listeners Our men of letters and the Nation's leaders are speaking to radio audiences. The clergy have taken kindly to the radio broadcasting idea, realizing that it is easier to preach to many a man and his family in the home than to expect them to come to church. Candidates for public office have not been slow to make full use of the radio telephone, for it is so much more genteel than touring the territory and delivering a series of stump speeches. There is no end to what broadcasting can do for the public—and for the man at the transmitting end.

We can view the present without difficulty, but when it comes to predicting the future of broadcasting we must move rather cautiously The radio telephone, in its present form, is by no means perfect, although it compares favorably with the usual phonograph In fact, by using a loud-speaking telephone in conjunction with a receiving set that includes a two-step amplifier, the music and talks can be heard in a large room with greater clearness and with less metallic or foreign sounds than the usual run of talking machines And the cost please bear in mind, is about the same as that of a corresponding phonograph The operating expense, it goes without saying, is practically nil, since no records are required for the radio set Occasionally the storage battery which operates the filaments of the vacuum tubes must be recharged, a matter of 50 cents or so and a high voltage battery, known as the "B" battery, employed in connection with the vacuum tube circuits, must occasionally be replaced at a cost of a few dollars. Then the vacuum tubes, which last from 600 to 1000 hours, must occasionally be renewed But even with all that, the maintenance cost is trifling alongside the cost of buying new records for the usual phonograph Still, the phonograph is by no means replaced for it serves a very definite function in the home. It affords the elements of choice, to be sure, whereas the radio-phone service is fixed and cannot be changed by its audience.

We are pioneering in radio broadcasting, that is certain. It must only be a matter of a few years when this novelty of today will have found its logical place in the practical workaday world. Radio engineers are cautious individuals, as we might well expect them to be. Who wouldn't be cautious, when the sputtering, uncertain, balky arc generator of yesterday's radio telephone suddenly became the simple, silent, steady and highly practical vacuum tube radio telephone transmitter of today? It was the realization of the impossible; a dream come true.

Yet certain radio engineers do not hesitate to say that broadcasting is going to develop along broad lines, and that in the very near future it will become part of our regular telephone system. The day is not far distant when there will be broadcasting stations throughout the country so as to cover every square mile by radio-phone service, and arrangements will be made so that anyone, paying the proper toll charge, will be connected with any desired broadcasting station. The advertising manager of a department store will give out a list of the day's bargains by telephoning from his desk to the nearest broadcasting station, where his voice will be automatically transferred to the radio-phone transmitting apparatus for broadcasting Government proclamations will be sent out by radio telephone, and confirmed by the printed word The police department will send out lists of stolen automobiles, descriptions of criminals, and other information by radio Even now certain police departments are planning to use the radio telephone for keeping in touch with their patrolmen.

Much remains to be done and too much care can not be spent in making broadcasting safe for the future. It must be kept in good hands, lest too many broadcasting stations get to work and only mess up each other's jobs and perhaps those of the Government and commercial radio telegraph stations. There is a definitely restricted number of available wave lengths in the "band" of wave-lengths which has been set aside by international agreement for such work. The radio broadcasting service must not be burdened with too much advertising or propaganda matter, for that would also tend to weaken its attraction to the multitude. And the quality of the transmission, as excellent as it is, must be bettered, while the receiving sets must be steadily improved upon so as to make them particularly excellent for radio telephone reception

If these various things are observed and carried out, radio broadcasting must continue to develop with virtually no limit in sight.

The Human Atmosphere

(Continued from page 200)

effects of the different forces upon the aura, complementary colored bands, etc The evidence which he adduces put this curious phenomenon well this side of the border land between science and quackery

It is interesting to note that an aura showing a decided color, such as yellow, does not necessarily become green when viewed through a blue screen, as one would suppose, but may appear as purple or some other color, showing that colors of the aura probably belong to another and higher spectrum than that which we ordinarily perceive.

Sometimes two colors will appear to the observer combined, such as blue and yellow, which appear not as green nor as separate patches of blue and yellow, the color sensations being delivered to the brain simultaneously as blue and yellow The effect is naturally bizarre.

Tests for Blotting Paper

BLOTTING paper is a very important article in any office and where large quantities of it are bought, it is essential that some standard method be used for determining whether the paper which is to be purchased is suitable for the purpose intended. Such large quantities are purchased by the Government that it seemed desirable a short time ago for the Bureau of Standards to thoroughly investigate the subject and see whether the tests commonly used in determining the quality of blotting paper were as satisfactory as they should be. As a result of this work, it was found that many of the tests were not successful in showing up those qualities in the paper which are desirable or otherwise. The tests finally recommended approximate as closely as possible the service for which the paper is actually used, and it is believed that a better quality of blotting paper will be secured as a result.

SCIENTIFIC AMERICAN

The Monthly Journal of Practical Information

35¢ a Copy ★ APRIL 1922 ★ $4.00 a Year

AN INCIDENT DURING THE RECENT AMATEUR RADIO TRANSATLANTIC TRANSMISSION TESTS —[See page 232]

Scientific American Publishing Co., Munn & Co., New York

The Scientific American, April, 1922, Volume 126, Number 4. Published monthly by Scientific American Publishing Company at 233 Broadway, New York N Y Subscription price, $4.00 per year. Entered as second-class matter June 18, 1879, at the post office at New York, N. Y., under the act of March 3 1879

Keep Four Silver Dollars in Your Pocket

and at the end of the year you will still have just four dollars, or a hole in your pocket.

Put four dollars in a subscription to "FORBES" (26 time-saving, business-informing, thought-stimulating, work-inspiring numbers) and before the end of the year you may gain ONE BUSINESS IDEA from a single issue that will multiply your $4 investment a thousandfold.

By way of illustration can you answer these questions:

What industries will be favored ones in 1922?

Do you know how to pick the best locations for stores in your city?

Do you know what mental tests should be used in picking your executives?

Can you tell how the United States Bureau of Standards helps manufacturers?

Are the stock and bonds that did best in 1921 still the best to buy in 1922?

Or is it time to sell the leaders of 1921 and to buy other securities?

If so—what others and why?

Is the farmer getting a square deal and what bearing does the present agricultural situation have on business recovery in general?

Do you know the way that freight rates can be reduced?

These and many other questions have been answered in recent issues of Forbes May not the answer to one of these questions prove to be worth infinitely more to you than the cost of a whole year's subscription?

Will you keep your $4 or put them to work here?

"FORBES"

120 Fifth Avenue New York, N Y

Please send "Forbes" every two weeks for a year starting with the next number I enclose check for $4 for the next 26 numbers, or I will remit on receipt of bill Canada 50c extra Foreign $1 extra

Name ____________________

Address ____________________

Firm ____________________

Position ____________________ SC AM 4 22

SONNEBORN PRODUCTS

LAPIDOLITH

TRADE MARK

Is a Modern Necessity For New and Old Concrete Floors

Lapidolize your *new* concrete floors as soon as they are laid. Then they will never dust or disintegrate. Flush Lapidolith on *old* concrete floors and dusting and disintegration is stopped and you have saved constantly mounting upkeep bills.

Over 200,000,000 Square Feet

of lapidolized concrete floors is a proud record of modern conservation in factories, schools and smaller buildings throughout the entire country, during the last twelve years.

Lapidolith, the original liquid hardener seeps in and chemicalises the concrete, so that it becomes harder than granite—wearproof, dustless—durable for many years.

SONNEBORN PRODUCTS

Cemcoat

the durable Mill White. Washable, fire-resisting, and of exceptional covering capacity Gloss, Flat and Eggshell All colors.

Lignophol

the modern wood preservative gives new life to old or new wooden floors.

Stormtight

the protective roof coating for all kinds of worn or new roofs Saves labor and material cost of new roofs.

Lapidolith is the standard, the unquestioned leader in its field—no other material approaches it, in performance or popularity.

When you use Lapidolith, you are assured of satisfaction The cost is insignificant, compared with the service rendered.

Write for testimonials from your city or town—also sample lapidolised block and full literature.

L. SONNEBORN SONS, Inc.
Dept. I, 264 PEARL ST , NEW YORK

SONNEBORN

Will You take

a delightful excursion into one of the most fascinating by-paths of science with

E-L. Bouvier

Member of the Institute of France, Vice-President of the Academy of Agriculture of France, Professor of the Museum d' Histoire Naturelle,

In his new work on

THE PSYCHIC LIFE OF INSECTS

IS THERE a more interesting field of intellectual speculation than mind in its lower and simpler forms? And is there a more fascinating phase of biological investigation than exact observation of the behavior which betrays these operations of the elementary mind? ¶ Here is a book as charming as Fabre in what Dr. H. M. Wheeler of Harvard calls its "lucid diction, its lack of dogmatic assertion, its kindly and stimulating tone." Its translator, himself an American entomologist of distinction, said "It has interested me enormously, and I feel sure it will have the same interest not only for students of some restricted field of biology, but also for all . . those to whom the constant question 'why' occurs." ¶ This refreshing and stimulating mental excursion into a field as yet comparatively unexplored is procurable at all bookstores, or of

THE CENTURY CO.
353 Fourth Ave., New York City

Price $2.00

With the Editors

FIRST of all, a few words about our cover painting. The general theme is radio—that subject so much in the public eye at the present moment The particular theme is the amateur radio transatlantic tests, conducted during last December by several young men who set up and operated a transmitting station on the outskirts of Greenwich, Conn. Their station was housed in a small portable building, heated by an oil stove, obviously these conditions, considering the intense cold of the mid-winter nights, were hardly conducive to warmth and real comfort. Yet these young men spent night after night adjusting their transmitting equipment and sending out their coded messages in the hope that they might be picked up by the representative of their radio fraternity located in Scotland for the duration of the tests. They deserved to succeed—and they did, with less than one kilowatt of energy, the 1BCG station spanned the intervening 3200 miles of land and ocean. Our cover depicts an incident during the sending tests at this little station.

THE terrible catastrophe which has befallen the Army semi-dirigible "Roma" was hardly to be thought of in advance Somehow or other, we have come to look upon the rigid type, as represented by the Zeppelin, with suspicion, for there have been so many accidents with this class of aircraft that almost instinctively we look for more of them. The semi rigid and non-rigid machines, however, have enjoyed a less disastrous career, these closely allied types have inspired some degree of faith in most of us, in and out of aeronautical circles. The smaller dimensions of the semi-rigid and non rigid airships, too, have made for a minimum of accidents, and when such accidents have occurred, they have not assumed the proportions of a catastrophe So in this issue, in a form that has already gone to press as these lines are written, there is a description of the "Roma" and her trial flights. It remains for us to tell the story of the "Roma" disaster in the May issue. Better still, we are going to tell the story of helium gas—that non-inflammable substitute for hydrogen—which is again in the public eye. Progress of real value has been made here, and we pride ourselves in having the latest facts.

WHEN word came from Kitty Hawk, N C., to the effect that two brothers, the Wrights, had made a successful flight in an engine-driven flying machine, every one was skeptical. Who wouldn't be, at that time, when virtually little had been accomplished in the way of flight even with the cumbersome lighter-than-air machines? Yet the word was the truth the Wrights had made a flight in a power-driven machine. And history is forever repeating itself Not so long ago word came out of Germany, telling of the wonderful soaring flights of German aeronautical experimenters. One experimenter was said to have made a flight of 21 minutes and 37 seconds in all directions, rising to a height of 200 feet and landing close by and but 40 feet lower than the starting point A difficult story to believe—quite on a par with the rumor of the Wright brothers' first flight! So we waited until the photographs began to arrive and until we could receive exact data from Germany Then we turned this material over to Mr L. d'Orcy, a recognized authority and writer on aeronautical subjects and one who, at first hand, has seen aviation develop from the first meet held at Rheims, France, to the present day. Mr. d'Orcy tells the story of the soaring birdmen in this issue, and he assures us that it marks the beginning of a new era in aviation

NOW and again it is our good fortune to be prophets. Sometimes our prophecies come true only after the lapse of many years sometimes we have but a short wait Thus in our March issue we had something to say regarding the excessive weight of railroad coaches, and we predicted that railroads would soon have to resort to lighter trains The limit of weight has been reached--surpassed in fact, and progress must now be made toward reduction of weight While we were writing those prophetic lines an experiment in weight reduction was going on in England. A radical change in the arrangement of wheels and trucks on passenger coaches has brought about the articulated train—the entire train becomes a single unit, instead of being assembled of separate coaches. We present an account of the articulated train in this issue, feeling that it points the way to a reduction of weight in American rolling stock

ELECTRIC lamps have come in for their share of publicity Recent investigations in New York City have disclosed some interesting facts regarding the cost of making electric lamps as contrasted with the selling price, and while it is distinctly out of our province to discuss the commercial end of lamp manufacture it is our work to tell about the manufacturing processes. There is a real story behind each electric light its production calls for the most intricate machinery—machinery that fashions glass into all kinds of shapes with the skill of the most experienced glass-blower, and that assembles delicate parts with a dexterity not even approached by the human hand Heretofore the facts regarding lamp production have been more or less secret, but we have finally succeeded in obtaining the latest data which is presented elsewhere in this issue.

INTEREST in Dr Carrington's article of January, "The Mechanism of the Psychic,' has been fully up to expectations. We do not recall that any single story has ever resulted in the necessity for our forwarding so many letters to the contributor The discussion which Dr Carrington has thus ably opened will be continued by at least two more articles in early issues. One of the staff will discuss the psychic manifestations—we have explained already the sense in which we use the term, and shall not further apologize for it—which pertain more strictly to the mind He will show one way in which these can be explained without the introduction of any supernatural element, and he will insist that these assumptions be disposed of, for or against—proved possible or disproved—before other and less happy explanations come into consideration And Dr Carrington will carry his story further, giving similarly an account of several of the more outstanding physical effects which have been produced without visible agency showing likewise the most plausible of the explanations which have been put forward to account for these, and making a few suggestions for further attack upon the problem of psychic research We believe that the general impression created by these two articles will be that, difficult and tenuous as this subject is, we are really coming to an understanding of it that compares favorably with that possessed, in their field, by the very earliest pioneers in electricity

CONTENTS

APRIL, 1922

LEADING ARTICLES

SHORT ARTICLES

DEPARTMENTS

SCIENTIFIC AMERICAN PUBLISHING COMPANY

Munn & Company, 233 Broadway, New York

Founded 1845

CHARLES ALLEN MUNN, President ORSON D MUNN Treasurer
ALLAN C HOFFMAN, Secretary

EDITORIAL STAFF

J BERNARD WALKER AUSTIN C LESCARBOURA J MALCOLM BIRD

DEPARTMENT EDITORS

ALBERT A HOPKINS, Notes and Queries
ISMAR GINSBERG, Chemical Engineer
VICTOR W PAGE Automotive Engineer
HENRY NORRIS RUSSELL, Prof of Astronomy, Princeton University

CORRESPONDENTS

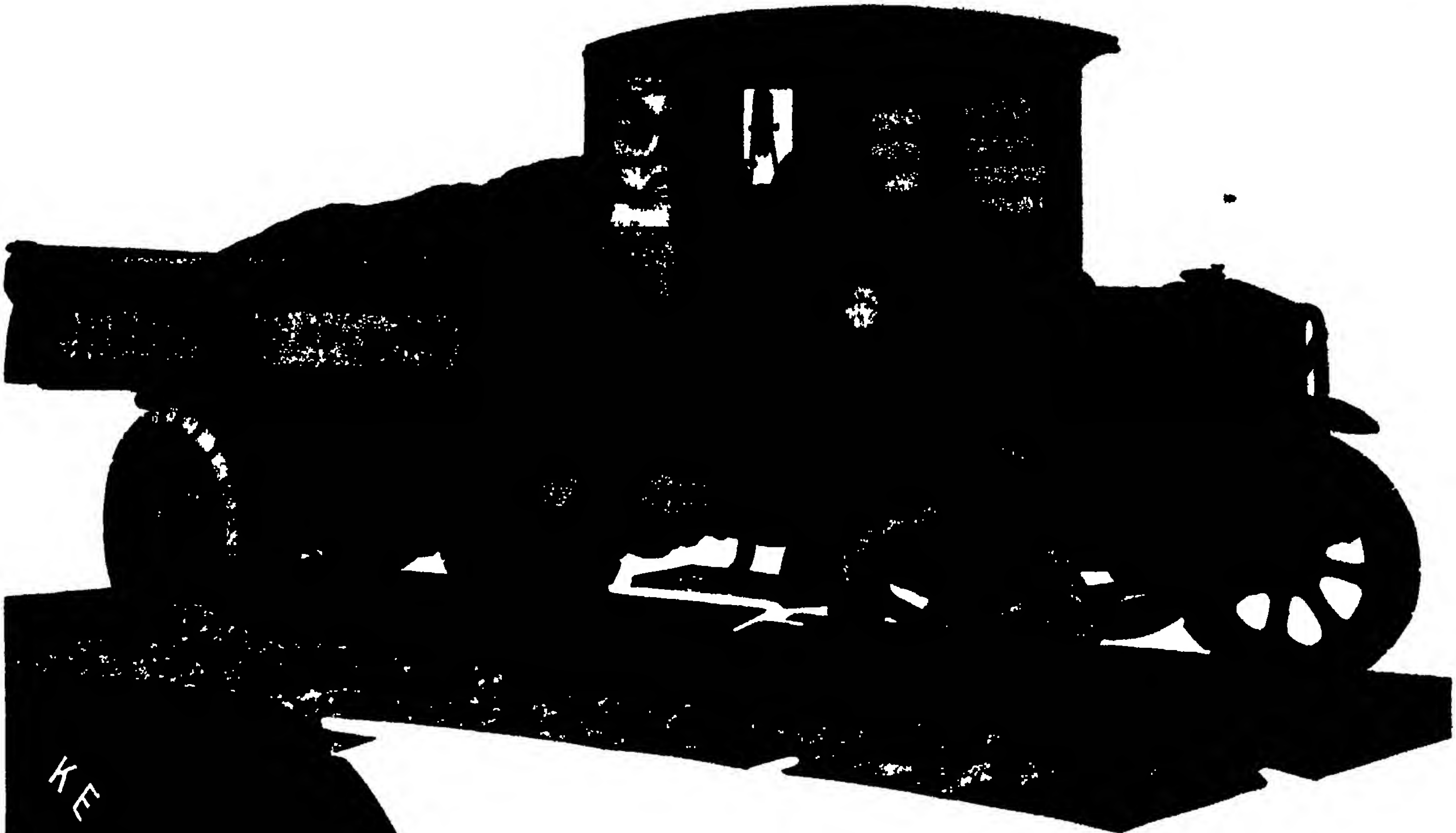
C. H. CLAUDY, Washington, D C. HECTOR C. BYWATER, London England
ALFRED GRADENWITZ, Berlin, Germany LEONARD W MATTERS, Buenos Aires, Argentine Rep

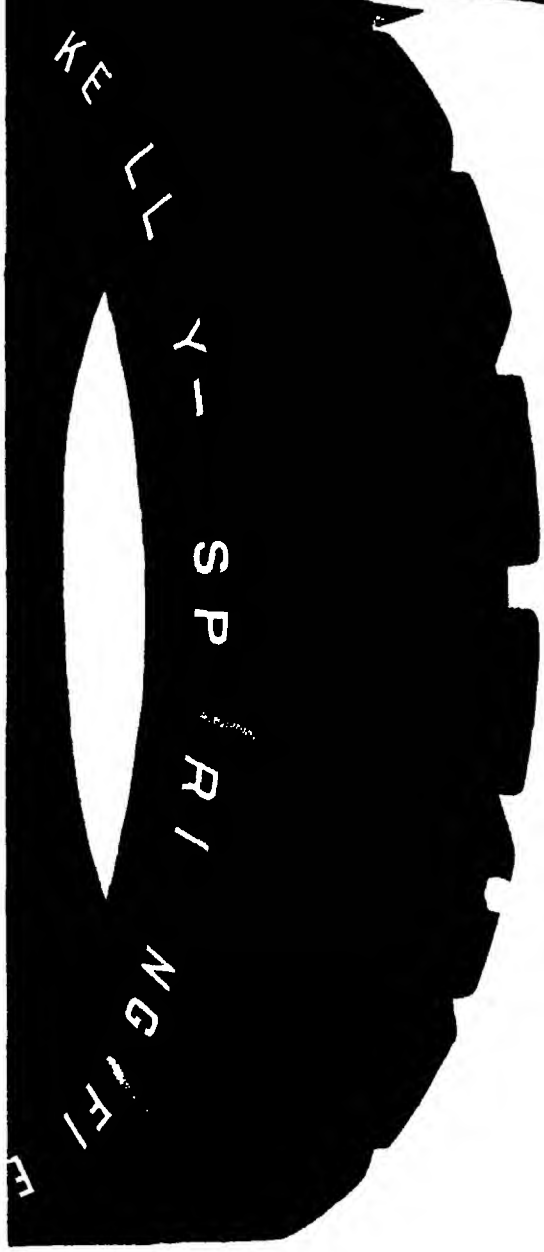
CORRESPONDING EDITORS

H DIEDERICHS, Prof of Experimental Engineering Cornell University
SAUL DUSHMAN, Ph.D., G E. Research Laboratory
EDWARD ELLERY Consulting Chemist, Union College.
RALPH J FOGG, Prof of Civil Engineering, Lehigh University
LEON A. HAUSMAN Ph.D, Instr in Protozoology and General Biology, Cornell Univ
HARRY S. HOWER, Prof of Physics, Carnegie Institute of Technology
M LUCKIESH, Dir of Applied Science, Nela Research Laboratories.
ROY W MINER, American Museum of Natural History
H F MOORE, Research Prof of Eng Materials, Univ of Illinois.
W A. MURRILL, Ph D New York Botanical Garden.
W C. PECKHAM Prof of Physics, Adelphi College.
H C. RAMSOWER Director of Agricul Ext. Service, Ohio State University
SAMUEL J RECORD Prof of Forest Products, Yale University
JOHN RITCHIE, Massachusetts Inst. of Technology
J HAMMOND SMITH Prof of Civil Engineering, Univ of Pittsburgh
EDWARD G. SPAULDING, Ph.D LL.D Prof of Philosophy, Princeton University
G. A YOUNG Head Mechanical Engineering Purdue University

Vol. 126 No. 4 Published monthly Entered as second class matter June 18, 1879 at the post office at New York, N Y under the Act of March 3, 1879

Price, 35 cents a copy $4.00 a year Postage prepaid in United States and possessions, and Mexico, Cuba and Panama; $4.50 a year for Canada. Foreign subscriptions, $5.00 a year postage prepaid.




KELLY-SPRINGFIE

SEVENTY-EIGHTH YEAR

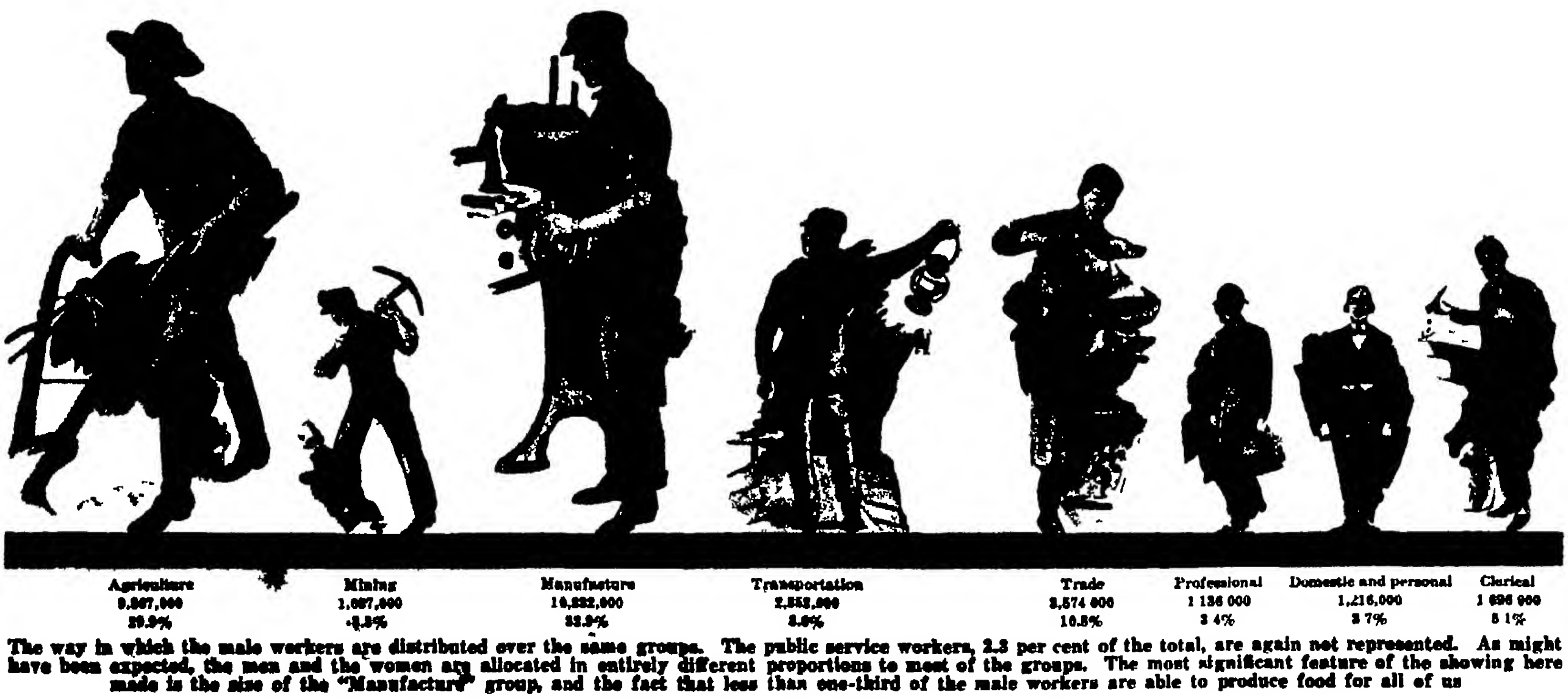
SCIENTIFIC AMERICAN

THE MONTHLY JOURNAL OF PRACTICAL INFORMATION

NEW YORK, APRIL, 1922

Agriculture	Manufacturing	Transportation	Trade	Professional	Domestic and personal	Clerical
1,084,000	1,931,000	214 000	670 000	1 016 000	2 184 000	1 424 000
12.7%	22.6%	2 5%	7 8%	11 9%	25 5%	16.7%

How our female workers are distributed over the several broad classifications into which the Census Bureau groups them The 0.3 per cent unaccounted for are engaged in mining and public service, but in such small numbers that they cannot be satisfactorily shown on the same scale with the groups above represented The "Domestic and Personal" group includes only hired workers, and not home-keeping wives and mothers, who are officially listed as without occupation



Agriculture	Mining	Manufacture	Transportation	Trade	Professional	Domestic and personal	Clerical
9,867,000	1,087,000	10,882,000	2,852,000	3,574 000	1 136 000	1,216,000	1 696 000
29.9%	3.3%	32.9%	8.6%	10.8%	3 4%	3 7%	5 1%

The way in which the male workers are distributed over the same groups. The public service workers, 2.3 per cent of the total, are again not represented. As might have been expected, the men and the women are allocated in entirely different proportions to most of the groups. The most significant feature of the showing here made is the size of the "Manufacture" group, and the fact that less than one-third of the male workers are able to produce food for all of us

HOW AMERICA'S MALE AND FEMALE WORKERS EARN THEIR DAILY BREAD

A radish from Chinese seed

World Crops for America

How Modern Science Combs the World for New Things to Eat, Picking and Choosing for the Menu of the Future

By R P. Crawford

Another vegetable giant from the Orient—udo, a Japanese product resembling asparagus

WHAT shall we eat a hundred years from now? Will it still be the conventional beefsteak and potatoes or shall we have entirely different appetites? What will our farms grow? Will it be corn and wheat or shall we be planting new crops of which America knows nothing today?

The civilized world did not always eat potatoes and many people only a few years ago regarded tomatoes—"love apples," they called them—as poisonous. We are continually changing and developing our appetites and what we regard as a weed today we may eat tomorrow

It must also be remembered that certain areas of our country are amazingly similar to areas in far-off lands. What grows successfully in other countries may be grown successfully in America under the same conditions. One part of our country may be undeveloped because apparently nothing can be grown there profitably but in a remote corner of the globe may be people living under exactly the same conditions.

There is today in the United States one organization whose sole work consists in finding new foods for America It is the Office of Foreign Seed and Plant Introduction of the United States Department of Agriculture Although it has had little recognition and few people know of its existence, its influence its correspondence and its explorers touch the far-off corners of the globe where white men seldom tread It is one of the most romantic of government bureaus Its explorers, whose sole duty is to discover new plants for America travel from the heart of Africa to the innermost recesses of China Its record of achievement is written in deeds quite as full of interest and as thrilling as more openly dangerous exploits When this office celebrates in 1922 the twenty-fifth anniversary of its establishment, it will have imported more than 50 000 different plants and seeds to be tried out in this country

Consider the date palm, as an example of one of its accomplishments. Dates are now being grown successfully in California and the Southwest, and the nucleus of a successful American industry is being formed There are now about a million date palms around Indio, California Experimental date orchards were established at Mecca and Indio, Cal, more than 15 years ago, and a large number of the best Old World varieties of dates have been tried out

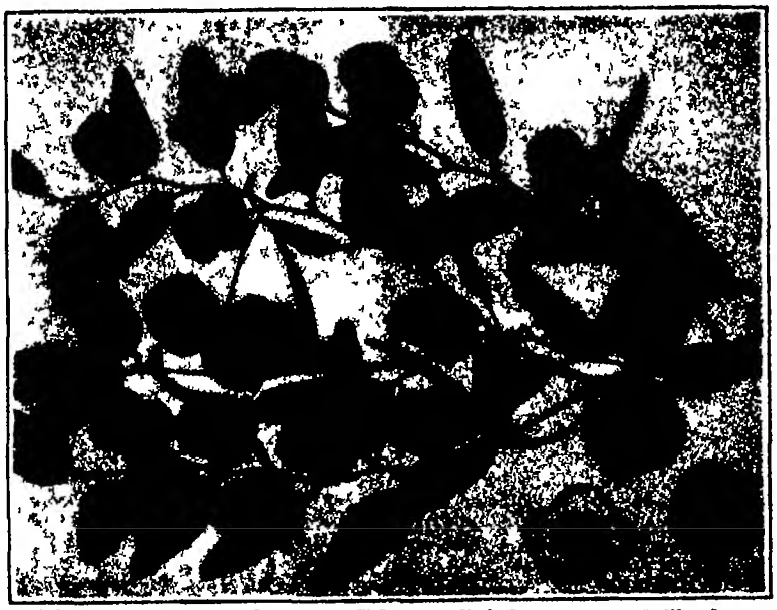
There is long staple cotton, which has become such a success in Arizona and neighboring States This was imported from Egypt "There is nothing comparable to the development of the long staple cotton industry unless it be the achievement of these East Indian magicians, and behold, a tree grows before one's eyes," is the way one expert put it The first plantings were made around Phoenix in 1900 For 12 months or so the experiments with this Egyptian cotton were carried on until it was felt that it could be grown on a commercial basis. The first year about 400 acres of commercial cotton were planted. A few years later the cotton crop of the Salt River Valley for one year would have paid the cost of two reclamation systems such as now supply it Long-staple cotton is used in making automobile tires, mercerized goods and some of the finer knit goods.

The Department of Agriculture spent $200,000 introducing a rice and establishing an industry in California worth in one year $20,000,000 Then there is durum wheat introduced from Russia Land in the Northwest that formerly would not grow crops now produces from 20 to 45 million bushels of wheat. The Department of Agriculture introduced the navel orange from Brazil and a single year's output in California amounted to 13,000 000 boxes.

In the Southwest and many parts of the plains States corn can not be grown The world was searched for suitable crops and the result was that the grain and forage sorghums were introduced Sudan grass, introduced from Africa only back in 1909, has now become a very popular crop in the Southern States and is growing in favor throughout the Middle West Peruvian alfalfa was introduced from Peru in 1899 It has been especially popular and suited to the southwestern and western coast of the United States. It starts growth earlier in the spring and continues later in the fall, with consequently more cuttings per season

These instances are perhaps enough to convince one of some of the things that have been accomplished for American agriculture by matching conditions in the United States with conditions in other countries where certain crops are being raised successfully Of course not all of these crops were developed entirely through the Office of Foreign Seed and Plant Introduction, because they are matters requiring the cooperation of different lines of agriculture and of individual farmers.

Before any new plant immigrants are permitted to enter the United States they must go through Ellis Island Not however the Ellis Island of the Russian and Polish immigrant for the plant importations have their own Ellis Island These field workshops and laboratories of the Office of Foreign Seed and Plant Introduction are located in Washington, D C , Miami and Brooksville, Florida Bell (near Glendale), Maryland, Bellingham Washington, Savannah, Georgia, and Chico California As soon as the new plant immigrant arrives in this country it must go to one of these stations to be officially inspected to see if it is a desirable citizen Some of the plants, like people, have diseases which if they ever gained a foothold in this country would prove disastrous. If they pass the examination, the seeds or cuttings are next planted at one of the stations. In a short time seeds or plants are ready for distribution to farmers and nurserymen who it is known are in a position to care for them As the seeds and new plants become more plentiful from year to year the distribution is made on a wider scale, and finally practically anyone who desires some of the new plants is given a few Those receiving the plants or seeds are expected to make reports as to their progress.



Jujube fruits grown at Chico, Cal. When candied they taste much like dates. It is indigenous in southern Europe and throughout tropical and temperate Asia

The station at Brooksville, Florida, was established to match the conditions in the moister but not tropical portions of China and Japan. The Chico station in California, because of its abundance of irrigation water, its high summer temperature, long growing season and mild winters, makes possible the trying out of widely varying crops. The Bellingham, Washington, station has to do especially with experiments with flowering bulbs. The station in Washington, D C., is where most of the disease inspection work is carried on, as well as many laboratory experiments of a miscellaneous character

There are few things more romantic than the work of an agricultural explorer Most explorers deal more or less with the evident things in a country. The agricultural explorer deals with things that to an ordinary person would be almost invisible. He must travel to the out of the-way places and study individual plants. The ordinary explorer would give them only passing notice To be a successful explorer one should also have a wide knowledge of agricultural conditions at home so as to be able to know a "find" when he sees it.

Probably few have done as much for agricultural exploration as has Barbour Lathrop, who was awarded some time ago the first of the Meyer Memorial Medals. Mr. Lathrop is a private citizen who has conducted numerous expeditions in search of rare plants the world over at his own expense Often he has taken representatives of the Department of Agriculture on these excursions and paid all the cost of the journey Mr Lathrop first took David Fairchild, now the head of the Office of Foreign Seed and Plant Introduction, with him On this trip he and Mr Fairchild concluded that the work should be done in a big way A plan was suggested to Secretary James Wilson of the Department of Agriculture, and he ordered it put into effect

Mr Lathrop and Mr Fairchild made a three-year agricultural exploration, visiting every continent and one-half of the countries of the world. It was on this excursion that the long-staple cotton, mentioned above, was introduced to America. This trip also marked the foundation of a real workable department, devoted to this line of work. That was some 20 years ago, and Mr Lathrop still continues his journeys, taking experts with him at various times. Some time ago he purchased a private bamboo grove near Savannah, Georgia, and presented it to the Department of Agriculture on a 99-year lease

One of the famous explorers of the Department of Agriculture was Frank N Meyer, who at his death a few years ago left the money establishing the Meyer Memorial Medal to be awarded to agricultural explorers. Mr. Meyer specialized in China, he had walked 10,000 miles through the heart of that country, Manchuria, Korea, and parts of Tibet and Russian Turkestan, looking for plants that might be of value in America. As David Fairchild once so aptly said of him:

"His hardy yellow rose peers in upon me through my study window, and up in the border his scarlet lily is in bud, while the perfume of his lilac has barely passed away His white-barked pine is dusting its pollen into the air, his Euonymous and his hardy bamboo are growing at the corners of the house, and his dry-land elm with its delicate branches shades the entrance. So much of China has he successfully transplanted to this country."

It is said that Meyer could keep in mind thousands of plants—even if he had seen them only once—and recognize almost instantly any that were strangers to him. He collected wild alfalfas in the Caucasus, Chinese Turkestan and Siberia, sorghums and Chinese pears in Manchuria; wild peaches and almonds in the Kansu Province, chestnuts east of Pekin; persimmons in the Ming Tombs Valley, wild conifers in the Wu Tai Shan, citrus fruits on the Upper Yangtze, bamboos and strawberry trees (the Yang mae) south of Shanghai, jujubes and the pound peach in the Shantung Province; dwarf almonds, dwarf cherries and apricots, and large fruited oleasters in Russian Turkestan, desert poplars and tamarisks, wheats and barleys in the desert region of Chinese Turkestan, wild apples and apricots in the Tian Shan range which divides Siberia and Chinese Turkestan, and large fruited currants from the Yakutsk Province of Siberia.

The life of an agricultural explorer is not an easy one. Mr. Meyer was once attacked by ruffians in Harbin and one time stood up against a wall to be shot but he managed to talk himself out of the uncomfortable situation.

It was only a few months ago that H. L. Shantz, another of the explorers of the department, returned from a 12 months' tour in Africa. Mr. Shantz traveled from Cape Town to Egypt, and, all told, journeyed about 10,000 miles over the dark continent. However, he did not find it as dark as it has sometimes been pictured and declared that most of the dangers of African travel have been greatly exaggerated. Mr. Shantz explored the wild jungle-country of the Upper Congo, and journeyed into the wild animal country of British and East Africa. And yet the party was not molested by either natives or animals. Mr. Shantz brought back more than 1000 specimens of African plants which will be tried out in America. One might name many other explorers who have done great things for American agriculture, but the brief stories of these three give some idea of the life of an agricultural explorer.

There are scores of novel and interesting plants which are just coming into use in America as a result of the plant explorations. Take the chayote, for instance. The chayote belongs to the cucumber family, and its native home is in Mexico and Central America. Today it is grown in some of our Gulf States and in Southern California. The different varieties vary in size from a few ounces to two pounds, or even more, and the color from dark green to an ivory white. Chayotes, if stored in a cool place, may be kept for several weeks. When prepared for the table, they are fried, stuffed, pickled, or baked with cheese.

There is the Assyrian pear. This was discovered by Frank Meyer, the explorer referred to above. The Assyrian pear is resistant to fire blight, which has been the bane of many orchardists. Experiments are now being carried on with this pear in Oregon.

The Japanese udo, it is believed, will become one of our most popular vegetables. It has a unique flavor and to a large extent resembles asparagus. It makes an appearance early in the spring, and can be blanched like endive and celery. The shoots which it yields are often two feet long and an inch in diameter. It does not have to be replanted more than once in ten years. The advantage over asparagus is that the white shoots of the udo are edible to their very base.

Then there are the mangos. There are said to be more varieties of mangos than there are of peaches. There are some no larger than a crabapple, and others which weigh six pounds. These fruits form a most popular food in India. At the plant introduction garden at Miami, Florida, the Department of Agriculture now has fruiting some 20 different varieties. The unpopular reputation which the mango received some years ago was due to the inferiority of some imported varieties. The better kind of mangos are as easily eaten as cantaloupes and have a delightful odor, much like that of pineapples. It is believed that the mango will become one of the most important products of southern Florida.

The production of Oriental persimmons is just getting under way in this country. The Oriental persimmons are hardly to be confused with the common persimmons grown down South. In Japan the objectionable pucker of persimmons is removed by packing them in barrels saturated with sake, and similar processes are being worked out in America.

The bamboo is now being grown extensively in a few plantings in the southern United States. The Oriental timber bamboo is said to produce its seeds not oftener than once in 40 years, so young plants had to be brought to America and tried out. Bamboo may be used for barrel hoops, trellises, light ladders, baskets, furniture, and even for food. The giant shoots, which sometimes grow at the rate of over a foot a day, when cooked form a great vegetable delicacy.

The dasheen, eminently suited to the Gulf States and the Pacific coast. When cooked it is, to all intents and purposes, a potato with the flavor of a chestnut

There are the jujubes, which are also comparatively new to this country. The jujube tree, which grows to be some 40 or more years old, is well suited to a large part of America, since there appears to be no weather too hot for it, although it must not have too much moisture. The fruit of this tree has a flavor unlike that of any other fruit and when candied tastes like dates.

A collection of plant immigrants arriving at Washington, where everything received undergoes a rigid examination to make sure that it does not harbor disease

The Chinese petsai is lettuce's great rival, and one gardener in New Jersey has grown it for several years. It can be produced for about half the cost of lettuce and will grow almost anywhere throughout the country.

The dasheen has often been mentioned. It is similar to the white potato, but when cooked has the flavor of chestnuts. It may be prepared in almost any way that potatoes can, and is cooked about the same length of time. In many parts of the Pacific Coast and Gulf regions there are places where the dasheen could be grown more successfully than any other crop.

The tung-oil tree is being tried out in the Gulf Coast States and in California. From the seed of this tree is made an oil which paint manufacturers consider one of the best drying oils known to the trade. Importations of the oil each year are estimated at between $3,000,000 and $5,000,000. The trees established in America seem to be doing well.

Most people are familiar with the pistachio nuts, the little green nuts used so often in ice cream and cake. Trees bearing these nuts have been introduced from central western Asia, and it has been found that they do exceedingly well in the Sacramento and San Joaquin valleys of California.

One might go on and enumerate almost indefinitely new plants which are being developed for American farms and gardens. There is a Chinese chestnut that is resistant to bark disease, a Chinese dry land elm that is resistant to extreme drought, neglect and extremes of hot and cold, and a sweet cherry that ripens ten days before the earliest cherries. The avocados are also becoming a popular fruit and possess a real food value.

One should not forget the flowering bulbs which are grown in such profusion at the Bellingham gardens. The famous Dutch bulbs for which American people have been paying around $2,000,000 annually can be grown quite as well in America. It has been discovered and in fact, the home grown bulbs in some respects are superior to imported stock.

The field of plant exploration is almost unlimited. In fact, its possibilities have hardly been touched. Out of the half million or so distinct plants grown on the globe man so far has learned to use only a few hundreds. We will not necessarily continue always to grow the plants we do now. Some of them are expensive food producers, some produce foods that are difficult to digest and some we may leave behind as we learn to like others better. The American food producer today can pick from the entire world the crops most suited to his land.

Thunderstorm-Breeding Spots and Engineering Design

AFTER discussing the probability that thunderstorms are likely to develop with more frequency in certain localities than in others, due to local conditions, Robert E. Horton, consulting engineer, Voorheesville, N. Y., suggests in the April *Monthly Weather Review* that the subject is worthy of study because of its relation to the design of engineering works. Mr. Horton notes that he has observed thunderstorms over cities, particularly Albany, N. Y., and Providence, R. I., "which originated immediately over the city and did not travel far outside their limits on days when there were no other adjacent thunderstorms." He expresses the belief that "some cities, if not indeed most inland cities of say 100,000 population or more appear to be thunderstorm spots." He also points out that "a shallow lake with sandy margins located in a forest may serve as a thunderstorm breeder" and cites as proof observations made by him over Oneida Lake, N. Y. Furthermore "Some western arroyos are notable for the frequency of occurrence of so-called cloud burst thunderstorms . . . whereas another adjacent to it might rarely produce them." The desirability of observations to show what particular areas, rural or urban, are what Mr. Horton terms "thunderstorm breeding spots" is urged as bearing upon the design of dams and of sewers. What Mr. Horton says in conclusion about cities breeding thunderstorms and the relation of this possibility to sewer design follows:

"An indication of the truth of the supposition that cities breed thunderstorms might be obtained by comparison of rain gages in the surrounding country with records taken in the city during the summer. Should it prove true that cities are in some instances thunderstorm breeders, whereas other nearby cities may not possess this characteristic, then such facts might have a very important bearing on various engineering problems, notably storm-sewer design, and might vitiate the utility of application of records of thunderstorm rain intensities in one city to another nearby city, even though the climate of the two places and the total rainfall per annum might be very nearly the same."

Applying the Lessons of Industry to the Theater

Ingenious Devices, Partly or Wholly New, Incorporated Into New York's Newest Play-House

GREAT improvement in theater building has been made in the past few years, largely with a view to the comfort and convenience of patrons. Methods and devices for handling scenery also have been improved and adopted by a few theaters, again with an eye to the patron, for these have been for securing clever stage effects or for shortening the wait between acts. Now comes a theater embodying all of these improvements, but designed also with the specific idea of making it easy for actors, electricians, stage hands, scene shifters and all others of the army of workers behind the footlights, to coordinate their efforts to produce a good play. Moreover, for the first time recognition is given by a theater to the fact that the quality of workmanship (in this case the play) may depend mightily upon the surroundings and environment of the workman.

The designing, especially of the stage and its equipment, has been gone about with precious little regard for precedent and tradition. Many of the old devices of the stage, which are present in nearly every stage in the country, are gone and in their stead is a collection of new devices which are so obviously good that we are forced to exclaim, "Why didn't someone think of that before?"

Our drawing shows the main features of the stage construction. The theater, from the rear of the house as far as the edge of the balcony, although elegantly appointed, does not differ appreciably from that in other new theaters. The first discrepancy we discover is the absence of the battery of spotlights usually located, with their operator, somewhere in the gallery. Instead there is a bank of floodlights so cleverly concealed in the decorations of the under rim of the balcony that the audience sees only their effect and never notes their presence.

The most striking innovation, perhaps, is the absence of boxes, which have long been a traditional feature of theaters, although a notoriously inconvenient and high priced spot from which to view a play. In the space on either side of the stage usually occupied by the boxes there are two miniature stages, which communicate from the rear with the main stage. Their most important use is for the purpose of acknowledging applause. When the main curtain descends at the end of an act it remains down and the time usually devoted to raising and lowering it to acknowledge applause is saved. The actor or actors, meanwhile, step to the miniature side-stages into the illumination of spotlights concealed in the balcony decorations. These stages also may be used for the presentation of a prologue, or in the cast of a large spectacular production may be easily connected to the main stage as "aprons," thus extending the available stage room across the entire width of the building.

Another feature which will be quite noticeable to the audience, and quite as puzzling, will be the sudden appearance of the orchestra, apparently from nowhere. The explanation is that the orchestra pit is really a huge hydraulic elevator, which can be lowered out of sight or raised to suit the occasion. The orchestra enters through the basement, and when ready to play is suddenly lifted into view of the audience. The elevator takes the form of a crescent, supported on several hydraulic lifts. The orchestra pit can be raised even to the level of the stage and used as an extension.

The effect which seems next most remarkable to the audience, no doubt, is that in out-of-door scenes the sky, instead of being a wavering "drop" of blue cloth, seems real and quite as limitless as the heavens themselves. This is accomplished by the use of a "horizont," a device which originated in Europe, and which has been used in one or two of the small "art" theaters in this country, but never before in a commercial theater here. The back wall of the building is simply shaped of smooth cement with curved corners. It is a neutral gray, and the stage director, through his electrician, paints upon this background in light the effect he desires—be it the effect of night, of dawn, or the shimmering heat of the desert noon. A small trench is constructed just in front of the wall so that workmen and actors may pass across the stage unobserved during the progress of an act.

Mr Earl Carroll, the designer of this theater, regards the adoption of the "horizant" as the greatest single step forward he has taken. "Playwrights have been very cautious," he said, "about writing out-of-doors scenes into their plays because of their unreality. I have experimented extensively with the horizant and I am convinced that this demonstration will cause it to be generally adopted. I think it will bring the out-of-door play, now almost entirely limited to the movies, to the speaking stage."

From the viewpoint of coordination of effort, an important change is in taking the electrician and stage manager from the "wings" and placing them at the very front and center of the stage in plain view of all of the players. They sit in a pit with their heads just above stage level, but are concealed from the audience because their heads are just below the line of vision from the topmost seats in the gallery over the footlight reflectors. From this point of vantage the director and electrician observe not only every light and every effect, as well as the actors, but through a telescopic peephole at their backs can see the entire audience and all of the house lights. Hitherto this was impossible because these two important men were located in the wings, where they had an imperfect and distorted view of the stage and no view at all of the audience and house.

The electrical arrangements alone for a large modern theater might well occupy a page of description here, but we shall have to note them briefly. The rheostats for "fading out" or "fading in" the footlights and floodlights are huge motor-driven affairs, while the great number of switches are of the remote control type and altogether occupy solidly a good-sized room. All are operated from a central control board by the chief electrician, who may have a number of assistants. In this new theater the electrician is provided with a master hand wheel to which his assistants "hook," electrically, the various apparatus he is using at a particular moment. For instance, if he is changing from the effect of dawn to daylight, the deep blue and red lights would be so connected that turning the wheel would slowly fade them out, while by the same movement the blue and white lights would fade in. Within reach of the electrician, also, are a great number of master levers by means of which he operates the switches in a room beneath the stage to secure his lighting effects, in much the same manner that the organist operates the stops on a pipe organ.

Another discarded inadequacy, small in itself but as old as the theater, is the peephole in the curtain. This has been replaced by a telescopic lens arrangement on either side of the stage, which gives an easy view of the entire audience.

The degree to which realism can be carried may be realized from the fact that the stage equipment includes a kitchen range with utensils and dishes for cooking and serving a full meal. When the lines of a play call for the serving of a meal it will be a real meal of real food, served piping hot from the kitchen in the wings.

The arrangement for handling scenery and drops also is noteworthy. The large pieces need no longer be pushed about by "main strength and awkwardness," but instead are whisked aloft by counterbalanced cables and secured there by a few men stationed on a platform some 60 feet above the stage. The counterbalances are buckets filled with buckshot, which may be emptied or filled to the proper weight. Thus a few men are able to perform the work that once required the services of a large number of scene-shifters. This system is coming into gradual use, but for the first time the theater designer has realized that it makes unnecessary the two wing balconies on each side of the stage, which are standard to theater construction. Once useful for raising and lowering drops by hand, these balconies lately have been not only useless but collectors of dust and junk.

One of the obvious improvements is a simple lift system for handling the trunks of performers with a minimum of effort. Of the scores of theaters in New York, it is said this is the only one where the moving of trunks does not involve the back-breaking expedient of climbing stairs.

The arrangement of dressing rooms for the players also marks a distinct step away from tradition. It has long been the custom to have two or three dressing rooms on the same floor with the stage for the use of the stars. These sometimes were elegantly appointed. The rest of the cast, however, had to climb stairs to stuffy dressing rooms with little or no regard for comfort and convenience. The space on the stage level of any theater is always precious, and that which might have been given to the stars' dressing rooms has been given over to a "green room," for the use of the whole cast and their guests. The room is a cozy one, artistically decorated, and with a mammoth fireplace at one end. It is expected that this room will not only serve innumerable social purposes for the players, but will be the scene of gatherings of notables, the reading of plays, and the like.

From the green room a marble staircase winds to the dressing rooms above. Something of the peculiar psychology of players has been taken into account in building the staircase, for half-way up one is confronted with a very cheerful "good-luck" statuette.

The theatrical world of New York never tires telling of the architect who, with his head in the clouds, undertook the construction of the ideal theater. All sorts of expensive and new-fangled things were introduced into the plans looking to the comfort of the audience and the better presentation of the play. But just in the nick of time, before actual work on the theater itself had begun, some practical-minded person got his eye on the plans and called the attention of the architect to the fact that he had omitted to provide a single dressing room of any description. Mr. Carroll has not repeated this error.

The players, in their dressing rooms, are given the same conveniences and service that they might expect in a great hotel. The rooms are fitted with shower baths and are elegantly outfitted and equipped. Excepting that the rooms for the stars are directly at the head of the stairs, there is no distinction between the treatment of star and chorus girl. The women's dressing rooms open into a common reception room, where they may receive guests, and which is fitted with an excellent library and lounging couches.

All of these improvements have involved the spending of thousands of dollars on the construction of the theater which might have been saved by ordinary construction. Many of them never are seen by the audience, and old-time theatrical men will contend, no doubt, that they contribute nothing to the value of a play, which after all marks it for success or failure.

Mr Carroll has spent large sums on improvements of this nature with the idea that they will make it easier to coordinate all of the myriad activities back of the footlights, that this will contribute directly to the success of any theatrical production staged there, and therefore to the financial success of the theater itself. "If this be idealism," says Mr. Carroll, "certainly it is a very practical sort."

Furthermore, the democratic treatment accorded the players is in direct line with a marked tendency in the theatrical world toward the labor conditions which obtain in industry. Most actors now belong to one of two organizations conducted along the lines of the labor unions. As a rule, conveniences for industrial workers in their leisure moments have not been carried to the extreme attempted in this theater, but similar methods applied to industry have paid definite profits. They enhance the interest of the worker in the enterprise and spur him or her to better effort at the machine—or before an audience.

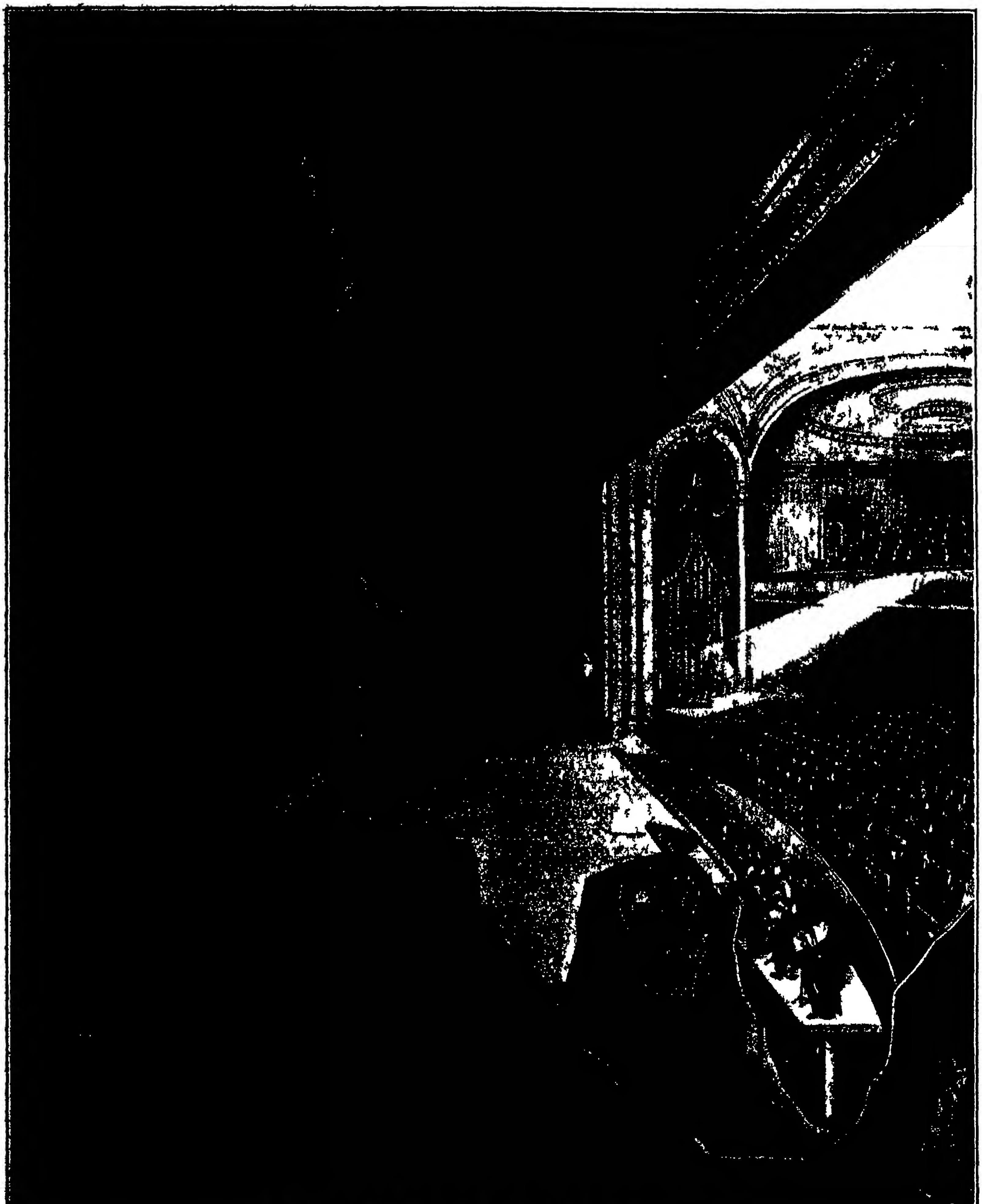
"We are not dragging art," declared Mr Carroll, "into the mire of industrialism. I do not think you will find a better appreciation of art in any other theater in the world. What we have done is simply to recognize established facts about human beings, and in applying them to the theater we have had to invent some new devices and discard many old ones, and have made the best use possible of those already at our disposal."

The theater, from the standpoint of seating capacity, is not a large one, having 1026 seats. This makes it possible so to arrange them that every seat is in direct line with the stage and there is hardly any choice, except as to distance from the stage, of any two seats in the house. Here is applied democracy for the audience, too.

Indicator for Emergency Landing Grounds

THE British Air Ministry is conducting tests with a new type of indicator for emergency aircraft landing grounds. The indicator takes the form of a large T-shaped steel frame over which is stretched white canvas. The frame will also be fitted with a vertical fin. This device will be mounted on a prominence; for instance, the roof of a small building, and will operate in the same manner as an ordinary weather-vane. The white canvas will make the device visible to airmen and they will be able to descend, gliding down head to wind.

Acetylene will be housed in the building on which the device is mounted and will illuminate the T at night. The wind strength will be registered and will operate a series of colored lights, so that airmen, by noting the color of the light, can determine the wind force along the ground.



GENERAL SCHEME OF THE STAGE AND ITS ACCESSORIES AT THE NEW CARROLL THEATER IN NEW YORK, SHOWING THE MORE IMPORTANT OF THE POINTS IN WHICH IT DEPARTS FROM THEATRICAL TRADITION

Articulated train used in Great Britain with excellent results. Note how the trucks are distributed throughout the train

Articulated Trains

A Method of Reducing the Weight and Improving the Riding of Railroad Trains

IN our last issue we drew attention to the increasing weight of rolling stock, and to the fact that the railroads were hauling much unnecessary deadweight over their lines. It was suggested that the great length of the cars was in some measure responsible for this condition. The present article affords a most opportune study of the question, particularly as the economies set forth have been gained in trains that have been in service for many years. These English cars would be too short, of course, for American requirements, but the principles on which they are built are sound, and the results are well worth careful study by our master mechanics and car builders. — THE EDITOR.

IN our March issue we discussed the subject of the rapid increase in the size and weight of rolling stock, with particular reference to the latest heavy Pullman cars. Shortly after that article was written, and very opportunely, we received from Mr H N Gresley, Chief Engineer of the Great Northern Railroad, England, the set of drawings and photographs herewith reproduced, which show the way in which that company has increased the capacity and reduced the weight of its passenger rolling stock. Mr Gresley writes us that the Great Northern Railway has over 200 sets of articulated coaches in use, some of which have been running for many years with such satisfactory results that the use of the system is being extended. Briefly stated what the company has done is to carry the ends of adjoining cars upon a single truck, in such a way that the couplings rest upon a common bearing, and the coupling pin of the cars serves also as the king pin of the truck.

In the articulated principle two or more carriages are permanently coupled together as shown in our illustrations. Each train, whether of two, or five, or ten cars, forms a unit, the trucks of which are so disposed that the distances between their centers throughout the train are all equal. In the train illustrated trucks are placed under the outer ends of each train the other trucks being placed under the adjacent ends of the car bodies forming the system. Sets of five bodies on six trucks have been running for many years on the Great Northern, and there is no constructional reason, or any other apparent reason, why trains consisting of 10 or 15 such cars should not be built, where the traffic calls for the use of larger units.

There are four principal advantages which have been proved in the experience of the company, with these trains.

1. *Reduced First Cost*.—Because the number of trucks is reduced there is a reduction in the total weight of the train, and because the trucks and wheels form the most costly parts of the train, both from a constructional and maintenance point of view there is a considerable reduction in the total cost.

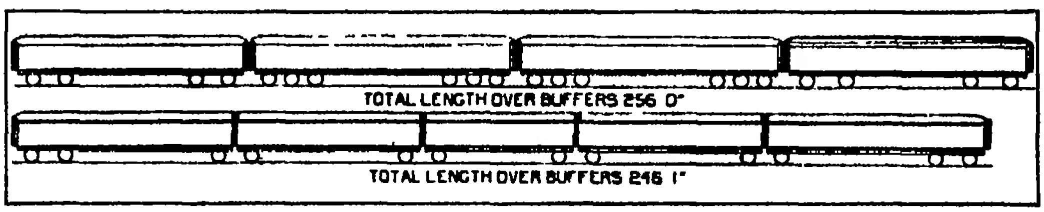
2. *Reduced Weight*.—The reduction in the weight of a train depends upon the number of cars forming the train unit the longer the train the greater the ratio of weight saving. Thus, as shown in one of the diagrams, the reduction for cars with four-wheel trucks ranges from 10 per cent to 14 per cent. Where six wheel trucks are used the reduction may run up to over 20 per cent.

3. *Reduced Running Cost*.—Reduced cost of operation is due to the reduced weight and decreased train resistance. This is, of course, most marked in the case of electric trains, since the consumption of current is practically proportionate to the dead weight of the train.

4. *Improved Riding of Cars*.—From the standpoint of the passenger, the most important quality is the improvement in the riding of the cars. This is due to the fact that there is no overhang of the bodies beyond the trucks, and that the adjacent ends of the bodies are carried on a common truck center. It is well known that the most comfortable part of a car is the center portion lying between the trucks, and this is due to the fact that there is here a minimum of lateral movement when entering curves. On the other hand the most noticeable lateral movement is felt at the ends of the coaches, or where they overhang the trucks. Of course, in an articulated carriage there is no end overhang.

We are also informed that the tendency to rolling is damped out in the articulated train since, although the individual cars are free to adapt themselves to the curves all relative movement laterally, or any tendency to roll between any two of the car bodies is prevented. It follows naturally that the articulated cars follow the true center lines of the track, and do not tend to nose from side to side as sometimes happens with the trains mounted on the standard system.

Attention is directed to the two illustrations showing a four-car, main-line train of the standard type, and a five-car train of the articulated type. The five-car train is 246 feet 1 inch over all as against 256 feet for the four-car train, a saving in length of 10 feet. There is in the articulated train a decrease of eight pairs of wheels, a decrease in the total weight of nearly 21 tons, and an increase of 10 first-class and 8 third-class passengers carried, in addition to an increase in the total baggage space of 2 feet 8¾ inches.



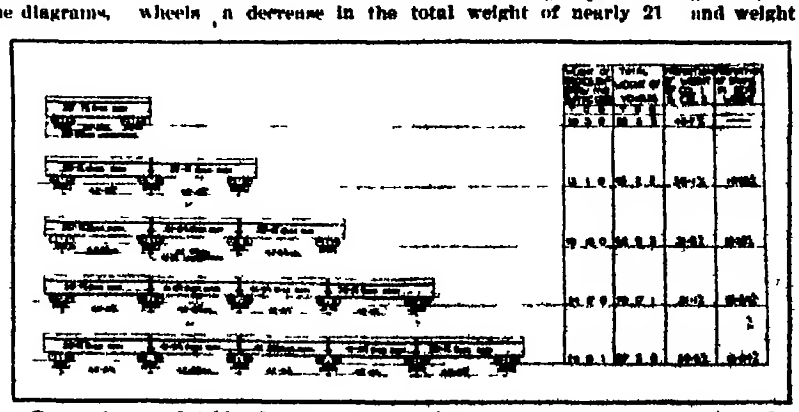
Although the articulated train carries 18 more passengers than the standard train (upper diagram) there is a saving of 10 feet of length, 21 tons of weight, and eight pairs of wheels

In a comparison of two other trains, in the articulated train there was a reduction in weight per linear foot of the train of 140 pounds, or 11.5 per cent, and there was a reduction in dead weight per passenger of 763 pounds per foot run, or 27 per cent. That these economies have not been obtained by any considerable reduction in the space per passenger, and certainly not with any noticeable reduction in his comfort, is shown by the accompanying view of the interior of one of the cars.

Dining Car with Electric Cooking.—Another feature of these trains which is entirely novel is that electricity, for the first time so far as we know, has been applied for cooking in the dining car trains. Current for the cooking apparatus is supplied by two generators supplemented by a battery. Each generator, which is belt-driven, is provided with self-contained automatic pole changers, and is rated at six kilowatts. As the length of the run between London and Leeds, where these cars are in service, is comparatively short, lunch has to be served soon after a start has been made. Hence, connections are provided by which current can be drawn from the terminal station supply, and the cooking be commenced before the start of the trains.

Across one end of the kitchen is the main cooking range and roasting oven, with a steaming oven above it, and above this are a grill and hot water tank. There are also a boiling range with four hot plates, two 10-gallon boiling pans for vegetables, a hot cupboard for heating the plates required, and an electric fish fryer. This installation has proved so satisfactory that other trains are to be suitably equipped.

In the article above referred to, as published in our last issue, it was pointed out that a considerable saving of weight could be effected by reducing the length of the cars, or to be more exact, reducing the distance between the bearing points of the car bodies upon the trucks. It may be contended that by the use of the articulated system the distance between supports is increased and the bending stresses, therefore, become greater, with a consequent demand for greater strength and weight in the structure of the car on this account. Undoubtedly this is true, but it should be understood that the articulated system presupposes the use of cars of comparatively short length. There is a length, beyond which the projection of the center of the car, beyond the inner rail on a curve, would become objectionable, although the cases in which this would happen would be rare, except on roads having unusually sharp curvature.



Comparison and table showing the main differences between the weights of articulated coaches and standard coaches

It will be noticed from the diagrammatic comparison at the bottom of this page that the articulated cars are only 47 feet in length. Evidently the fact that the points of support are outside the car bodies instead of eight feet in from the ends has not involved a heavy construction in the car body. This is doubtless due in some degree to the way in which the steel channels of the under-

frame have been brought in and concentrated near the end bearings.

Our railroad officials are straining every nerve to cut down operating costs. Here, in the elimination of dead weight, would seem to be a field of action upon which they might make a study of the problem to good advantage.

The Toronto Meeting

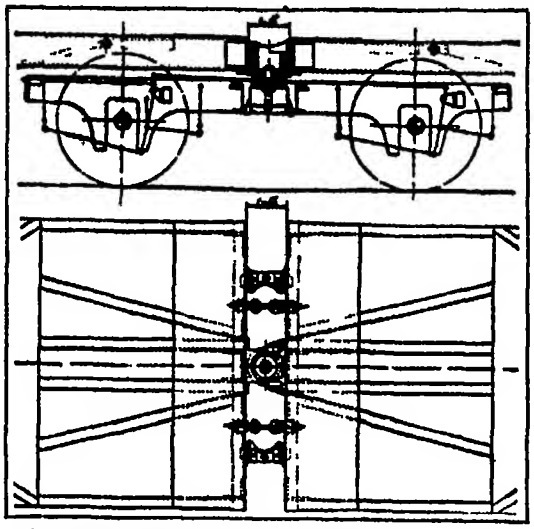
THE thirteenth annual meeting of the American Phytopathological Society was recently held at Toronto, Canada. Prof. J H Faull of the University of Toronto had charge of the phytopathological exhibits. Section G of the A. A. A. S. and the Mycological Section of the Botanical Society of America assisted as usual with the program where the subjects and discussions were of mutual interest Of the 2000 present at the general meeting, about 200 were botanists. The next president of the Botanical Society of America is H C Cowles. The new officers of the Phytopathological Society are: E. C. Stakman, president N J Giddings, vice-president, Perley Spaulding, editor-in-chief, with L. L. Harter and G M Reed, assistants. The meeting next year will be held in Boston.

The most popular address was probably that by Prof Bateson on "Evolutionary Faith and Modern Doubt." The symposium on the "Utility of the Species Concept" was important and well-timed. Mosaic diseases occupied a prominent place at the meeting, about 20 papers being presented dealing with this subject Dr Duggar experimented with the mosaic disease of tobacco and found that the "virus" filters through porous cups as a liquid and therefore cannot be a germ or similar organism He termed it a "living fluid contagion." Experiments by Johnson, who has long worked on tobacco mosaic, led him to make the following statement "It seems, therefore, that these results furnish evidence against the enzymatic theory of mosaic while at the same time they favor a parasitic hypothesis, since the temperature curve for the development of mosaic corresponds closely with that of the development of many of the plant pathogens."

Freda Detmers discussed the parasitic effect of polypore, *Poronidulus conchifer*, on elm branches, claiming that it seems to be more injurious at times than suspected L. M Massey discussed "Fusarium rot" of the Gladiolus. The corms become infected in the field and the rot advances in storage The fungus seems to be *Fusarium oxysporum* Schecht A poplar canker, caused by *Hypoxylon pruinatum*, was described by Povah This disease is a trunk canker, which blackens the sapwood It is very serious in certain sections. W H Snell spoke of the effect of heat upon the mycelium of certain structural timber-destroying fungi within wood, concluding that heating structures affected with decay to 47-48 degrees Centigrade by means of the heating systems, as has been suggested, would not kill the fungi even in moist cotton weave sheds, although the drying effect would be beneficial in certain types of structures. The application of these results to the effect of kiln drying upon structural timber decay was pointed out R J Blair spoke of experiments with storing wood pulp in water to protect it from fungi An experiment was carried out using several kinds of commercial pulps in order to test the preservative value of water upon sheets of pulp immersed in it. After an interval of 17 months the pulp was examined and tested for freeness. It was then made into small sheets of paper, which were tested for bursting strength and for tensile tear. The pulp stored in water came through the test in much better condition than that which was piled on a shed where it was given an opportunity to dry out

Air for the Miners

WARNING that in every abandoned shaft or pit or, in fact, any old working where the air has been stagnant for a considerable time, there is always danger of oxygen deficiency, with consequent peril to the life of anyone exploring such workings, is given by the United States Bureau of Mines. Frequently lives are lost through the cleaning out of old wells, which accidents, as a general rule are also caused by impure



This shows ends of two cars carried upon a common truck. Note the combined coupler and kingpin

atmosphere Instances of loss of life through a lack of proper precautions in entering abandoned exploratory shafts and pits are frequently reported to the Bureau of Mines Recently a geologist was killed through entering an abandoned exploratory shaft in California without making a preliminary test of the shaft atmosphere In Minnesota a mining engineer lost his life from being overcome by poisonous gases while sampling a shallow pit in iron-ore formations.

All the gases found in pure air are without color, smell or taste, but no reliance can be placed on these senses for detecting impure air, declares the Bureau of Mines. Air so impure that it will not support life may not have any disagreeable odor or choking effect that would warn the breather to escape Oxygen deficiency in the air of old shafts and pits or other workings may be caused through replacement by carbon dioxide or methane and absorption of oxygen by the rock and timber

In old metal exploratory shafts carbon dioxide is more commonly present than methane. Carbon dioxide gas is generated by decaying timbers, is given off by certain rocks, and may be carried into the shaft by circulating waters. This gas, being heavier than air tends to settle in the still atmosphere of the shaft rather than mixing with the air Thus at one point in the shaft the air may support life, but a very short distance below consist of irrespirable "black damp In openings in coal measures some oxygen is absorbed and some carbon dioxide is given off by the coal. Old abandoned workings often contain large quantities of black damp, because the atmosphere is motionless and the oxygen has been removed by long contact with the coal In addition to carbon dioxide, methane (fire damp) is also given off by the formations.

When the oxygen of the air in a mine opening is so low that a miner's oil lamp, candle burning paper, or torch is extinguished a man should not go or stay in such an atmosphere A candle or an ordinary miner's safety lamp will be extinguished in an atmosphere containing less than 17 per cent oxygen and an acetylene or carbide lamp in air containing 12 or 13 per cent oxygen

While a man might live or even work in air containing 17 per cent oxygen, it would be a most hazardous undertaking to enter or remain in mine air that extinguishes a flame, since this shows only that there is less than 17 per cent but not how much less Before any abandoned shaft or pit is entered one should lower either a lighted candle or lantern or safety lamp to ascertain the condition of the air If the flame is extinguished, and there is not sufficient oxygen in the shaft air to support life, one should not attempt to enter the shaft until the air is stirred up by some common means.

Raising and lowering a bucket several times, to bring in fresh air from the surface, is common practice After working it up and down vigorously for a few moments the air at the bottom of the shaft should again be tested with a flame If there is no bucket available the air should be churned by means of a blanket, tent fly inverted umbrella, or other large, light object attached to a rope Methane may be expected in abandoned shafts or pits driven in coal measures or carbonaceous slates, or where a heavily timbered shaft is partly filled with water If methane is suspected it is best to lower nothing but a miner's safety lamp. If the light is not extinguished the descent can be considered reasonably safe When no safety lamp is available and it is necessary to test with an open light, care should be taken to withdraw immediately all persons in close proximity to the shaft or pit as there may be an explosion It would be safer to clear the shaft before making any test with an open flame It is common practice among metal mine prospectors to throw burning grass or lighted paper into an abandoned pit or shaft, but there is a possibility of fire starting if there is combustible material in the shaft bottom

Generally there is no physiological warning of oxygen deficiency in the air The first decided feeling is one of extreme weakness accompanied by dizziness, better described as partial paralysis, and the victim collapses practically without warning To guard against this danger a man should not enter old workings without having a rope tied around his body and at least two men on the top The rope should be kept taut Then if a distress signal is given the explorer will not only be prevented from falling but can be quickly pulled to fresh air and his life saved.

Interior of one of the first-class cars, showing the upholstering, also hatracks carried above the backs of seats

The kitchen, in which the cooking is done by electric current furnished by generators, belt-driven from the axle

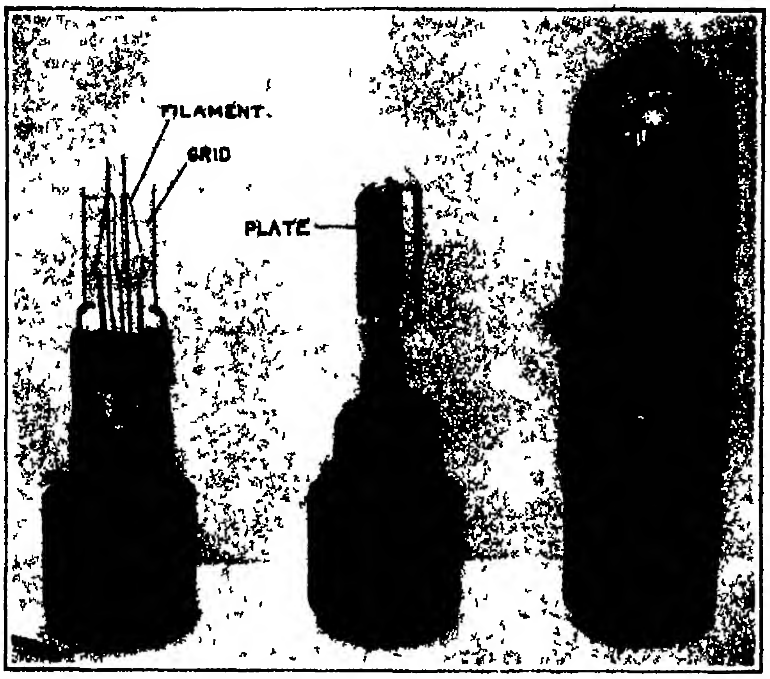
At the Sending End of Radio

Spanning the Atlantic with Fifty Watts of Electrical Energy, and a Few Facts Regarding CW Transmitters

By Pierre Boucheron

FIFTY watts of electrical energy was recently used in the successful spanning of the Atlantic without cables or wires or other physical connection. Fifty watts—a mere trifle as electrical consumption goes! The average electric light draws 50 watts, yet the light which it gives forth could hardly be detected at a distance of two or three miles. Yet when this same amount of electricity was applied to a highly efficient continuous-wave radio transmitter it spanned the 3600 miles of land and sea separating the amateur radio operator in this country, wondering if he was 'getting across,' and the representative of a leading American radio organization, temporarily located in Scotland with a collection of receiving apparatus for the purpose of picking up the attenuated waves from fellow workers back home thus proving that low power transmitters, in the hands of capable operators, could connect the Old and the New Worlds.

That marvelous feat of signaling which has given rise to considerable comment on the part of scientists and engineers throughout the country, took place during the latter part of December, when the so-called amateur radio operators of the United States, through their official association, the American Radio Relay League, conducted a series of tests to determine the possibilities of international amateur radio communication. To this end they sent an expert from their ranks, Mr. Paul F. Godley, to England with detailed instructions to "listen in" between 7 P. M. and 1 A. M. each night from December 7 to December 16, inclusive. Definite operating periods were arranged for amateur stations which in preliminary tests had qualified for transmissions of 1000 miles or more; also other time intervals were allotted as a free-for-all transmission period.



Oscillating vacuum tube of 50-watt rating, such as used by 1RU of Hartford, Conn., in transmitting across Atlantic with 50 watts of energy

There were many doubting Thomases in and out of amateur radio circles, who insisted that transmission on low wave lengths—200 meters or less, and at small power outputs—not to exceed 1 kw.—was a ridiculous impossibility, and that sending a man over to Europe to prove it was even more so.

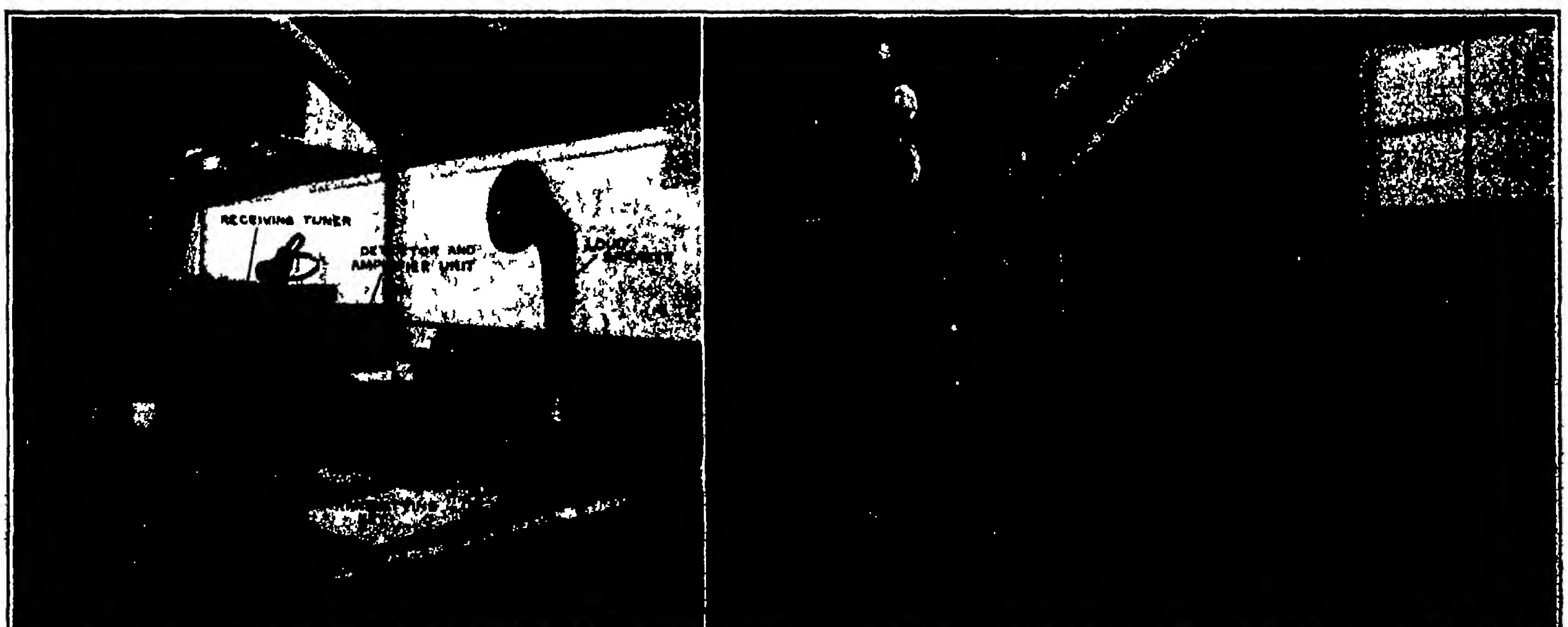
Nevertheless, the amateurs of America were in a fever heat of excitement when the first test night came. Needless to say, practically every amateur station in the country, even those equipped with comparatively small transmitting sets, began calling their colleague stationed at Ardrossan, Scotland, where he had erected his own personal receiving set, utilizing such supersensitive devices as the famous Armstrong regenerative circuit in connection with vacuum tube amplification.

On the first night of the tests Mr. Godley reported *having heard an American amateur signing the call* letters 1AAW. This, however, could not be verified, as the official owner of this call was not operating at the time specified. On the second night the observer reported no signals heard on account of a severe storm prevailing at the time in Scotland. The storm caused, among other physical disturbances, excessive static discharges through the air and static, it will be recalled, is the *bête noir* of all radio activities.

On the night of the 9th, however, conditions were ideal, and for the first time in the annals of amateur radio, short-wave, low-power, transatlantic communication became an accomplished fact. It was at this time that Mr. Godley reported in his daily return radiogram sent via the high power commercial route, that he had picked up the signals of the American amateur station 1BCG, and that these signals were strong and reliable. After this, and until the closing day of the tests, December 16, 1BCG and other stations continued to "carry across the pond." In all, these stations numbered 27. Not only were some of these stations heard clearly in England and in Scotland, but in one case an entire message was copied in Amsterdam, Hamburg, and in the Catalina Islands, proving that the signals were radiating equally well in other directions.

So we behold the amateur radio art spreading out to international proportions. In the future it may well be that Smith of Chicago will spend an evening playing chess with his friend Watkins in London, whom he has never seen, the next evening Smith may hold a good-natured discussion on international politics with MacPherson of Glasgow, the third evening Smith may practice the French language with Cartier of Paris. Why not? It can be done, and surely a radio get-together *party of this sort must help to foster* amicable relations with other nations as no other agency can do.

Perhaps the most powerful of the stations competing in the recent epoch-making tests is 1BCG, the first to be heard. This plant, which employed a power input of about 900 watts for the transatlantic tests, is located near a lonely back road on the outskirts of Greenwich, Conn. It was somewhat hurriedly erected in order to compete in the transatlantic tests. Another touch of romance is that 1BCG *is not a one-man station. It is owned and operated* jointly by some of the country's most representative radio experimenters, who have worked, played, eaten and talked radio for the past 15 years—men, not so long ago boys, who have seen the art graduate from Marconi's crude 10-inch spark coil and the unreliable coherer, to the present-day highly effective vacuum tube transmitter and receiver. These men are Major Edwin H. Armstrong, who devised the now far-famed regenerative circuit, E. V. Amy, a short-wave antenna expert, J. F. Grinan, who, strangely enough, was not only the



Right: Transmitting corner. The four transmitting vacuum tubes can be seen on the bench; in this case four [illegible]-watt tubes are being used. One tube is being used as a master oscillator, the other three as amplifiers of the energy produced by the initial source. The total input to the plates of these four tubes was [illegible] watts. The radiation was [illegible] amperes, with a total operating efficiency of 52 per cent, or approximately [illegible] watts of antenna energy. The transmitter operated on a wavelength of [illegible] meters. *Left:* Receiving desk of the same station, with the actual transmitting key which controls the relay key on the transmitter table. Modern vacuum tube receiving units are used here.

Two views inside the 1BCG amateur station which transmitted across the Atlantic during the recent tests

first man to send an amateur radiogram across the American continent, but who also was the first to send an amateur transatlantic message of congratulation, which was received in Scotland by Mr. Godley even to the last dot; while George E. Burghard, Minton Cronkhite and Walker Inman complete the personnel of 1BCG

This station is housed in a small portable building, and the long winter nights were cold, but not too cold to dampen the zeal of these dyed-in-the-wool radio men. Our cover illustration depicts a thrilling moment in the little shack during the transatlantic tests, as the writer, who attended these tests, recalls it.

An analysis of the report on the technical facts connected with these tests indicates that of the 27 stations heard across the Atlantic, 24 employed the new form of radio transmission known as the continuous-wave or "C.W." method, with power inputs ranging in most cases from 50 to 100 watts. This new system has made great strides within the past year, owing to its remarkable carrying powers, selectivity, simplicity and low cost, as compared with the older spark type transmitter

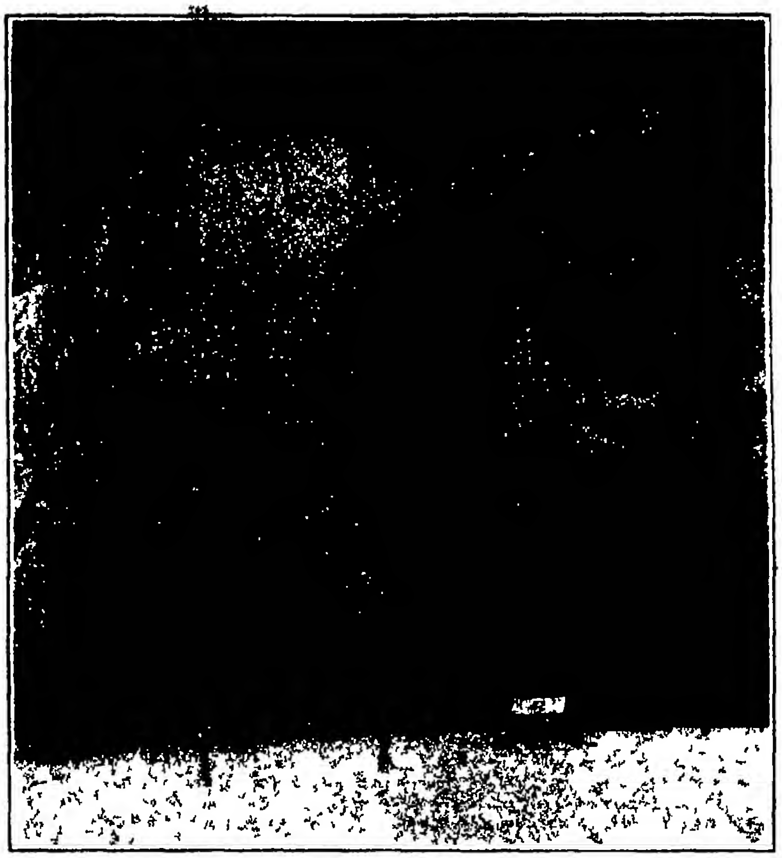
Briefly, the difference between the continuous-wave and the discontinuous or damped-wave method is this In C W we have a system of transmission which generates and propagates a perfectly uniform wave of *constant* amplitude. Such a wave, after leaving the antenna, travels through space without losing its form The distance this kind of wave will travel is, of course, entirely dependent upon the amount of power at the initial source Modern C W may be obtained by several distinctly different methods. The most popular method, at least among amateurs, is realized through the use of the oscillating vacuum tube. Here we have the somewhat magical performance of a glowing incandescent lamp generating a constant supply of high frequency oscillations, which is ideally suited to radiation purposes through the simple expedient of controlling the electronic flow occurring between the lighted filament and a surrounding plate charged with positive electricity

In the discontinuous or damped method the emitted wave is not continuous in its passage through the ether Furthermore the amplitude of its oscillations is not constant. Instead, after such waves have been given their first send-off by the initial power stroke of the transmitter, they rise to sudden great height and gradually fall lower and lower in amplitude until *damped* out completely The next stroke of transmitter energy causes them to rise again, and the rising and falling process keeps on indefinitely, depending on the amount of energy back of it. Thus this sort of discontinuous or damped wave, as it is technically called, travels through space until exhausted, likewise, its "carrying" powers are entirely proportional to its initial amount of energy It is produced by the spark type of transmitter and has been in use ever since the inception of wireless communication.

C. W., being constant in amplitude, does not dampen out and is, therefore, known as an *undamped* wave. The discontinuous wave, on the other hand, not being constant in amplitude, dampens out quickly and is, therefore, known as the *damped* wave The first is a much better medium for bridging great distance at small cost, and, therefore, is slowly supplanting the older method. Then, too, it has decidedly selective qualities not readily attributed to the spark system. In other words, a radiated C. W., when intercepted by the receiving station, is so sharp and constant in character that the receiver must be tuned exactly to its wave length, otherwise it will not affect the instrument. When we consider that there are to date 13,835 amateur transmitting stations in the United States, and nearly 300,000 receiving units, this sharpness of tuning is a most important factor in eliminating interference between stations, indeed, in time to come it must supersede entirely other less selective methods of transmission.

Possibly the second most attractive feature of C. W is its great economy in power consumption. For instance, power for power, C. W. will carry five times the distance spanned with the older spark method. Indeed, it is not uncommon for a 1 kw vacuum tube transmitter to outdo a 5-kw. spark type set. By the same token, the over-all efficiency of a vacuum tube transmitter is quite high as compared with the spark, the first being close to 70 per cent, while the latter is seldom over 35 per cent. This greater efficiency, please note, means considerable economy in power consumption, and quite naturally finds ready approval among communication engineers. Still another decided advantage of the C. W method is *its comparative simplicity of apparatus*, eliminating, as it does, cumbersome transformers, huge condenser jars and ponderous spark dischargers of the stationary or rotary types. C W being practically noiseless, operating conditions are greatly improved Moreover, the operator is enabled to send and receive almost simultaneously, without having to manipulate large change-over switches.

The use of vacuum tubes in transmission makes possible not only C W but also I C W, or interrupted continuous wave operation, as well as radio telephony *These three functions of the vacuum tube have played* a most important rôle in the present-day usefulness of radio in general C W has already been described I C. W is practically the same form of transmission with the exception that a mechanical interrupter is inserted in the radiating circuit of the transmitter in order to "break up" the emitted waves so that they will be heard at universal audible tones at the receiving end, otherwise, a special receiving circuit must be employed to render the waves audible, as is done in C W work.



The mast to the right is 100 feet high the one at the left is 80 feet The antenna is of the so-called cage type, T-shape, a new form of aerial construction especially effective in continuous-wave transmission on account of its uniformity The flat-top section of this antenna is 100 *feet long and its down-lead is placed in the exact center, and measures about 80 feet long* Instead of a ground connection, a counterpoise forms the other part of the radiating system The counterpoise is simply a secondary antenna system located a certain distance below the actual antenna and a certain distance above the *ground*

General view of 1BCG, showing the station building, the masts and the antenna system

Radio telephony is, so to speak, a combination of both C. W and I C W That is, a radio telephone transmitter is normally emitting continuous wave oscillations at radio frequencies—frequencies above 10 000 cycles per second When speech takes place the oscillations are modulated by the characteristics of the voice, and these changes cause a superimposed rising and falling amplitude of the wave.

It is obvious that the continuous wave at once lends itself admirably to any requirement of the present-day radio art. *First, it may be used in its natural wave form* (C. W) for long-distance radio telegraphy, whether for amateur or commercial purposes; secondly, it may be modified as in I. C. W. (interrupted continuous wave) to meet the receiving requirements of the older spark type installations still in use on thousands of vessels and land stations; and thirdly, it may be modulated by the human voice, thereby permitting radio telephony, now so popular owing to the great success of the radio telephone broadcasting station.

The rôles which C W is capable of playing combined with its inexpensiveness, simplicity, selectivity and carrying powers as recently and conclusively proved make this the ultimate transmission system—*the one which will supplant all other present-day systems* for amateur short wave long distance communication In commercial work it also finds ready application, especially where dependable medium-power communication over medium distances is required. To this end, commercial transmitting units of the vacuum tube type are today fitted for C W, I C W and radio telephone operation any one of which is instantly available simply by the turning *of a master control switch*

The success of the recent amateur transatlantic tests had no sooner been reported than persons, not familiar with *operating* conditions, began to ask why it was possible for amateurs to operate overseas on such low-power outputs as 50, 100, 250 and 900 watts of electrical energy when it took as much as 200 000 watts (200 kw) for commercial stations to bridge similar distances, a quite natural question and one that is easily answered To begin with for the amateur operator to span the Atlantic during a special *prearranged period at the most* favorable season of the year under particularly advantageous operating conditions, was one thing and to furnish the public with reliable commercial service over the same distance during 24 hours of each day of the year, winter and summer, through heavy atmospheric disturbances and under the worst as well as the best operating conditions, is quite another thing They compare as day with night *one means transatlantic communication* at times the other means transatlantic communication *all the time*

In extolling the advantages of C W and its various applications one fact stands out in bold relief, and that is the predominating part played by the vacuum tube Without this wonderful device, so young in years yet so old in its training and broad usefulness many of our present radio achievements would not exist. To-*day the vacuum tube—call it the electrical* acrobat or the modern Aladdin's lamp, if you will—finds many applications in the electrical industry but certainly none so useful as in radio work where it plays stellar rôles in both transmission and reception of radio telegraphy and telephony

In a few brief years we shall see the vacuum tube responsible *for feats of long-*distance communication undreamed of today But who is responsible for this wonderful achievement? The answer is to be found in the research laboratory where year in and year out, unsung and seldom mentioned investigators toil quietly and indefatigably that mankind may be benefited.

The Last Glacial Epoch

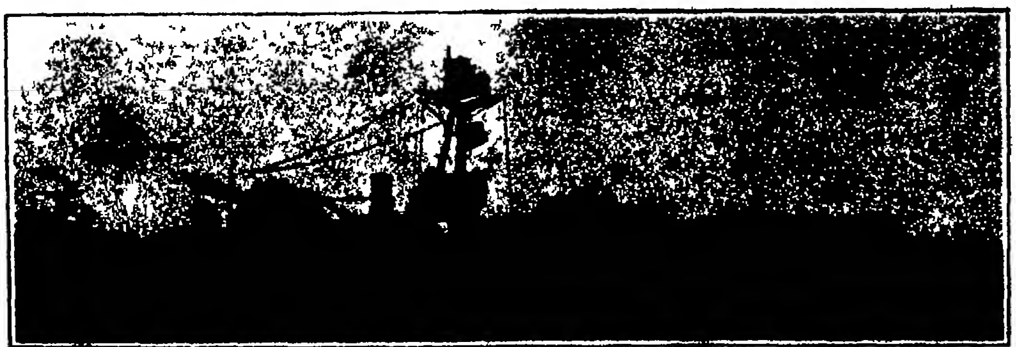
MR C E P BROOKS (*Quarterly Journal R Met Soc* July, 1921) assigns the date 20 000 to 18,000 B C., for the last great glaciation in northwest Europe (Ireland, Scotland Scandinavia, and the Baltic) Some remains of glaciation continued until 6000 B C , after some intermediate phases the date 1800 B C to A D 300 is assigned to the Peat bog Phase when the climate was cooler and more moist than at present These changes are attributed chiefly to alterations of elevation Increased elevation *has the double effect of producing glaciation* on land and of closing the Straits of Dover and other channels for the warm currents from the Atlantic Mr Brooks also assigns considerable weight to the 1800-year cycle in tide-generating force announced by Mr O Pettersson. But it is very doubtful whether this cycle will explain any appreciable climatic changes. It does not mean that all the tides are higher at one of these 1800-year maxima but merely implies that there are a few tides in the year very slightly in excess of those at other epochs, just as there are total solar eclipses *of maximum duration at something like the* same interval Evidence of an approach to simultaneity in climatic changes in Europe and America indicate some cosmical cause but the suggestion of a long-period variation in solar output (analogous to the short period variations announced by Mr Abbot) seems, to a commentator in *Nature*, more hopeful than the tidal cycle theory so long in vogue.

The First, and Last, 18-Inch Naval Gun

The Leading Naval Powers Have Agreed to Build No Guns Greater Than 16-Inch

By Hector C. Bywater

THROUGHOUT his long career in the British Navy the late Lord Fisher preached a doctrine of tactics which could be compressed into a single sentence "Locate your enemy and knock him out with a succession of tremendous blows." As far back as the early eighties of last century he worked out, in collaboration with Sir Philip Watts, the naval constructor, the design of a "super-Inflexible," to be armed with eight 16-inch 80-ton muzzle-loading guns. This was rejected by the Admiralty of the day as being too costly a proposal, and it was not until Lord Fisher became professional head of the Navy in 1905 that he was able to put his "knockout" theory into practice by building the dreadnought. He was stigmatized as a materialist because he always advocated the biggest ship, the highest speed and the heaviest gun. It was under his impulse that Britain built the "Lion" class of battle cruisers, the wonder ships of their day, and intended to overhaul anything afloat by virtue of their tremendous speed and then to pulverize the quarry with salvos from their 13.5-inch guns. Scarcely had these ships been built than Fisher was aiming at something better, particularly in the way of artillery, and his next step was to introduce the 15-inch gun, firing a projectile of 1920 pounds, as against the 1400-pounder of the 13.5-inch and the 850-pound shell of the 12-inch gun. On being recalled to the Admiralty in October, 1914, he arrived with his pockets stuffed with plans for novel types of ships wherewith to smash the German fleet. He was the father of the famous "hush" cruisers—the "Glorious," "Courageous," "Furious," "Renown" and "Repulse," in all of which very high speed was combined with a battery of the heaviest guns then available. The first three were officially designated light cruisers," although they displaced 18,600 tons. This was a specimen of Fisher's grim humor. The British Cabinet refused to sanction new capital ships, holding that the exigencies of the war demanded priority for destroyers and patrol craft, but they were willing to let Fisher build light cruisers. He promptly decided to go the limit by constructing three "whoppers"—to use his own expression, two of which were to be armed with four 15-inch guns apiece, and the third, the "Furious," with two 18-inch guns. All these ships were intended for work in the Baltic where Fisher intended to dispatch a strong British squadron to cover a Russian landing on the German coast. His purpose was to outrange any artillery the Germans could bring up, and he therefore instructed Armstrong, Whitworth & Co to design a gun that would shoot up to 25 miles. This was the origin of the 18-inch gun, the heaviest and longest ranging piece of naval ordnance which has been built up to the present time. The new guns were put in hand early in 1915. As their dimensions were much larger than those of any gun built previously, the work involved technical difficulties of a serious nature, but the first specimens were completed in well under 12 months. Meanwhile, however, Fisher had left the Admiralty and his Baltic plan of campaign had gone by the board the ships which he had built for this special enterprise having been diverted to the Dardanelles, the Belgian coast, and the Grand Fleet. The "hush" ship "Furious" had been redesigned as an aircraft carrier, mounting but a single 18-inch gun, and even this was removed shortly afterward. As no other vessels were designed for an 18-inch armament, these colossal guns became so many white elephants, and were finally offered by the Admiralty to Admiral Sir Reginald Bacon, commanding the Dover Patrol. Admiral Bacon was at this time working on a plan for the long range bombardment of Bruges, the headquarters of the German U-boat flotilla in Flanders, and he therefore accepted the offer with alacrity. His first idea was to mount one or more of the guns ashore at Westende, whence they could pitch their shells into Bruges without difficulty, but the execution of this scheme was conditional on the Allied armies advancing sufficiently far along the Flanders seaboard to turn the Germans out of their positions on the coast. This, however, could not be done at the time, and Admiral Bacon was therefore compelled to devise floating platforms for his monster cannon. Three monitors were chosen for the purpose—the "Lord Clive," the "Prince Eugene," and the "General Wolfe." They had been hurriedly built in 1914-15, and each was armed with a couple of old 12-inch, 35-caliber guns taken from the "Majestic" class of battleships. As time was of vital importance, it was decided not to remove the original armament, but simply to mount one 18-inch gun on the after-end of the superstructure of each monitor, on a carriage capable of 15 degrees of traverse and 45 degrees elevation. Special magazines were dispensed with, the cordite charges being stowed in racks on the upper deck, protected by water-jackets against ignition by enemy shells or bombs. The shells were housed on the upper deck at an angle of 30 degrees, with a space between each to avoid one detonating the others if hit by enemy fire. To reinforce the decks against the weight of the gun and the force of the recoil a good deal of extra scantling was worked in. The gun itself was mounted behind a shield of thin plating as camouflage to represent armor. Unfortunately the work was not completed in time for the three monitors to carry out their bombardment of Bruges, and only the "Lord Clive" was able to discharge a few rounds at the enemy before the Armistice intervened. Admiral Bacon's program for the Bruges bombardment was to moor the three vessels behind a smoke-screen in a position at sea 24,000 yards from the Zeebrugge lock-gates and exactly in line with the Zeebrugge-Bruges canal. A few ranging rounds were to be fired at the lock-gates, after which the elevation was to be increased and 18-inch shells to be dropped right into the submarine shelters at Bruges. Spotting would have been done by aircraft. From the technical point of view it is a pity that the shooting did not come off, for it would have constituted a record in long-range naval gunnery.

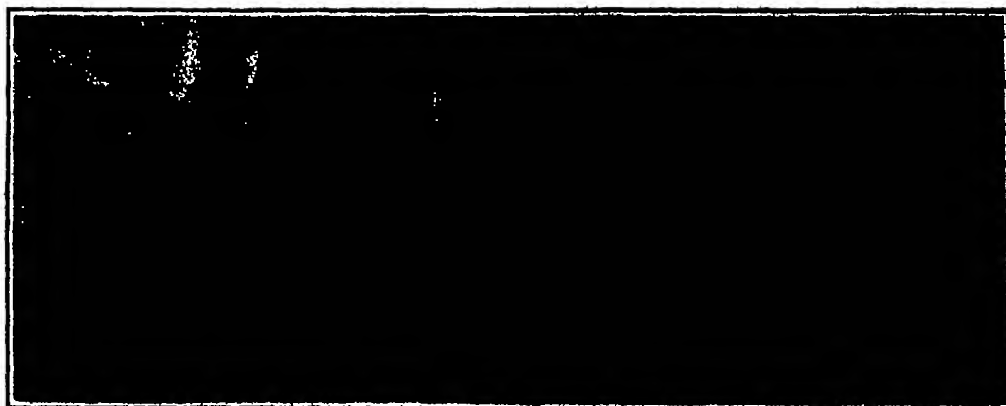


Monitor "Lord Clive," with 18-inch gun on improvised mounting astern. Designed to shell submarine shelters at Bruges from a position 24,000 yards at sea from Zeebrugge

The 18-inch gun on the Proving Ground, with a 4-inch gun alongside. Weight, unmounted, 152 tons. Designed to fire a 3320-pound shell with a muzzle energy of 150,000 foot-tons. Penetration of hard-faced armor at short range, 41 inches; at ten-mile range, 30 inches. Accurate up to 50,000 yards

Except for its size, there is nothing particularly remarkable about the 18-inch gun. It is constructed on the wire-wound principle which has been in vogue in Great Britain for so many years, but which, in the opinion of many ordnance experts, has outlived its utility. Wire guns, it is true, have a generous factor of safety, and this was a powerful recommendation some 25 years ago, when powder was inclined to be erratic in its action, and gun-bursts were not infrequent. Nowadays, however, when the propellant is so much safer and the stresses to which the gun is exposed can be gaged to a nicety, the safety factor is of less importance. The wire gun is much heavier than the built-up type, and being also deficient in girder or longitudinal strength, it is liable to lose its accuracy. It is understood that British gun factors are reverting to the

(Continued on page [illegible])



Group of 18-inch Hadfield armor-piercing projectiles, each over seven feet long and weighing 3320 pounds

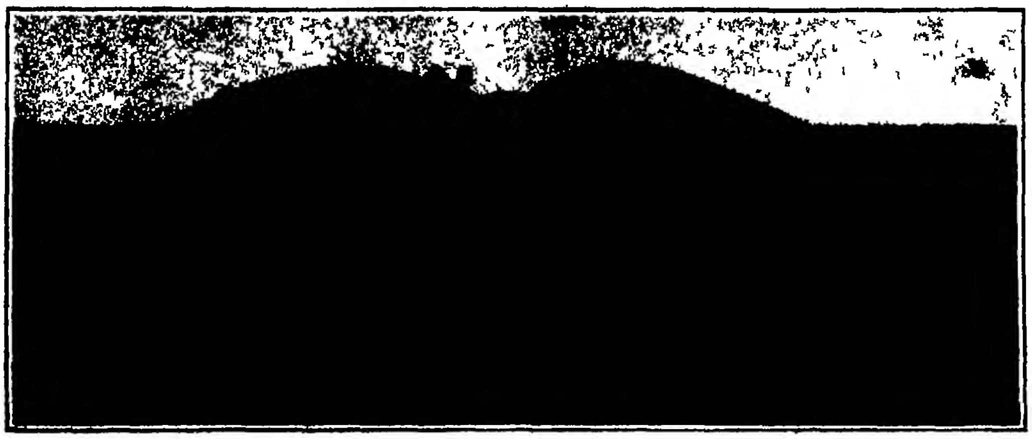
Soaring Birdmen

A Study of Soaring Birds and a Review of Recent Glider Experiments in Germany

By Ladislas d'Orcy, M. S. A. E.

FOR the past two years an important movement has been under way in Germany with a view to solving the long-sought problem of artificial soaring flight, or motionless flight, without loss of height. This movement has gained a large impulse from the fact that it is directed by a central organization, the Association of German Model Airplane and Soaring Clubs, and also because it has the active support of some of the most influential German airplane constructors and aerodynamical investigators. Among these may be mentioned Prof. Prandtl, director of the aerodynamical laboratory at Göttingen; Prof. von Kármán, well known for his theoretical work on the resistance of the air, Prof. Hugo Junkers, inventor of the all-metal monoplane bearing his name, and E. Rumpler and A. Fokker, the airplane constructors.

In addition, the German soaring movement derives a certain amount of patriotic inspiration from the fact that this branch of aviation was initiated some thirty years ago by Otto Lilienthal, the great pioneer of flying. Although Lilienthal's gliding flights from the top of an artificial hill 50 feet high afforded the starting point for the invention of the airplane by the Wright brothers, it is a matter of historical record that Lilienthal himself was much less concerned with the achievement of power flight—as were his contemporaries Ader, Langley and Maxim—than with the solution of soaring flight. Even when he was led to admit the desirability of fitting a power plant to his glider, Lilienthal only intended to use it in emergencies—that is, when he would be unable to derive sustentation from the wind.



The Schwerdt soaring machine, which has hawk-like wings and is most attractive in appearance

What Is Soaring Flight?

By soaring flight is meant the kind of flight practiced by the larger species of birds (albatrosses, vultures, eagles, hawks, buzzards, sea gulls, etc.) which consists in progressing through the air without any apparent expenditure of energy—that is, without the flapping of wings. Certain birds soar in this manner for hundreds of miles, and the albatross is said to follow steamships for days without ever flapping a wing when no wind is observed near the surface of the sea. There may be a certain amount of exaggeration in this statement, for soaring birds are known to flap at times; but it is a fact that this maneuver is engaged in only occasionally, probably when the wind veers, and the bird is forced to tack, so to speak.

It is generally conceded that the soaring birds derive the power of sustentation from the wind, for the great majority of observers are agreed that no soaring flight ever takes place in a dead calm. On the contrary, it seems that the higher the velocity of the wind, the more extended and regular are the "flapless flights" of the most perfect soarer—the albatross. This also appears to be borne out by what we know of the structure of the atmosphere, namely, that the velocity of a wind generally increases with height, for the best soarers habitually fly at great heights.

ON December 17, 1903, Wilbur Wright succeeded in making at Kitty Hawk, N. C., the first controlled power flight in the history of the world. For five years the incredulous world laughed at the idea, and branded the Wright brothers as impostors. On September 13, 1921, Herr Harth, a German aeronautical experimenter, on a motorless soaring machine, rose without any outside assistance from an absolute standstill to a height of 200 feet, and flew in all directions for 21 minutes and 37 seconds. The accompanying map shows the course followed by Harth on his soaring flight, the starting point being indicated by a circle, while the landing point is indicated by a cross. But the map tells only part of the story: it does not indicate that Harth, following his remarkable soaring flight, landed at a point only 40 feet lower than the altitude of his starting point. Here, indeed, is a remarkable achievement and, like so many others now being realized, must make for a new era in aviation characterized by low-power planes and an all-round raising of aero-dynamical standards. It is this phase of aviation, together with a study of the flight of soaring birds, that we asked Mr. d'Orcy to treat.—THE EDITOR.

Structure of the Soaring Birds

If we compare the structure of the various soaring birds, we notice that the greater the ratio of the wing spread to the length of the body—that is, the slenderer the wings are, the better is the soaring ability of the birds. It may be noted, incidentally, that the birds which are incapable of soaring, and which propel themselves through the air by flapping their wings, all have a much smaller spread length ratio than even the poorest soaring birds.

The wing shape of the various high capacity soaring birds does not differ materially among them, except that the sea birds do not as a rule possess the highly sensitive hook-like tip feathers which characterize the land soarers. Land soarers generally extend their wings either horizontally or at a slight dihedral angle above the horizon, while the sea birds hold their wings arched downward like a bow. Both of these differences may be due to different atmospheric conditions prevailing over the ground and over the sea—about which we as yet know very little.

It is worth noting that the most capable soaring birds are by far the heaviest birds in existence, so that the ability to soar seems to depend to a certain extent upon a mass, or momentum, whereby the bird acquires and retains initial velocity when there is no wind. This assumption is plausible on the ground that the larger bird has a greater inertia per unit of surface area, since the mass of the body increases as the cube of the diameter, whereas the surface increases only as the square of the linear dimensions. The fact that the albatross is a much better soarer than the sea gull—the former being the much larger and heavier of the two—seems to justify this theory.

Finally, there appears to be a distinct relation between the size and shape of the body of soaring birds on one hand and their wings on the other. That the body is so shaped by nature as to produce the most even "flow-off" of the air stream which strikes the bird is self-evident, judging by what wind tunnel experimentation has taught us about the value of streamlining in reducing parasitic resistance. But aside from this it is quite possible—as some soaring experimenters claim—that the body of soaring birds is so shaped as to direct the wind upon a particular portion of the wings, whereby the bird is enabled to derive the maximum efficiency from soaring. Whether this hypothesis can be proven or not remains to be seen, but the question seems worth investigating in a wind tunnel.

The most generally accepted theory of soaring flight is that two sources of energy are available for its accomplishment. One consists of the so-called ascending air currents—that is, winds blowing on a rising slope, the other source is furnished by rapid changes in the speed and direction of the wind.

Ascending Air Currents

Ascending air currents, or "upwinds," are frequent in any uneven country when the wind is blowing, for every natural obstacle in its path—a hill, a sand dune, a wood etc.—deflects its course in an upward direction. In addition, upwinds are also created, although on a much smaller scale, by the uneven absorption of solar heat by the ground, due to different coloring. Thus, a certain portion of the ground, by absorbing more heat than the portion adjacent, will create a rising current, while as a natural reaction a descending current will occur over the colder portion. If this process is multiplied many thousand times, it will become apparent that the atmosphere, like the ocean, is more or less in perpetual motion, although to the observer on the ground it may appear to be in a state of calm. Our perception of this motion is undoubtedly far inferior to that possessed by birds, who seem to have the faculty of "seeing," or rather sensing, the flow of air—if the continuous head movements of soaring birds is taken into consideration.

Over the sea ascending air currents are created by the wave motion, each individual wave giving the air an upward deflection. From this it is easy to understand why the best soaring birds are sea birds: over the sea upwinds of some strength must almost continuously occur because the underlying medium is never entirely still, whereas in the case of land it is chiefly the shape and coloring of the earth which determines the existence of upwinds.

In addition to all this, upwinds are also created by meteorological conditions, such as cloud formations, from which the complexity of the question will be appreciated.

How the Birds Soar

However, careful observation of soaring birds shows that upwinds alone do not produce soaring flight. When a soaring bird starts to "take off," he generally runs head on into the prevailing wind, flapping his wings until he meets an upwind, when he begins to describe circles. This circling flight of soaring birds is probably due to the limited extent of upwinds. In his ascension the bird still flaps occasionally—to trim sails, so to speak—but less and less so as he rises, probably because soaring conditions improve with height. When the bird has reached a certain altitude, he changes from circling to rectilinear flight, soaring with the wings rigidly extended.

From the above it appears that the soaring bird uses ascending air currents for being lifted from the ground, but once he has reached the height favorable for soaring, he must obviously emerge from this region of up-

wind which, as we have seen, is of limited extent What then continues to support the bird and furnishes besides propulsion while its wings remain motionless?

That indeed is the great problem of soaring flight, and none of the available theories gives an entirely satisfactory answer to it We have said before that in addition to upwinds a source of soaring energy is believed to exist in the irregularities, or rapid changes in speed and direction of the wind When these fluctuations are of great strength the bird is supposed to utilize them by presenting the greatest possible resistance to a gust and the least resistance to the ensuing lull In this manner the bird equalizes the wind fluctuations, for every time it takes" a gust it increases its energy by an amount equal to that which the wind loses, so that it stores up energy in a gust, and spends it in a lull Of course, such a maneuver means the sacrificing of speed for height (in a gust) and of height for speed (in a lull), so that according to this theory the soaring flight of birds would consist of a series of undulations This maneuver may be observed at times, but it is the exception rather than the rule with the best soarers, who are capable of flying straight like an arrow—hence there must be a flaw in this theory

The "Secondary Fluctuations" of the Air

But there exists another theory of rather recent date which affords a much more convincing explanation of how birds soar straightaway when they emerge from the region of upwind It has for some time been assumed that the air particles which make up the substance of the wind— that is, of a given volume of air in motion, are continuously in a state of a very fine vibration which is similar in principle to the wave like motion underlying the structure of many other physical manifestations (sound light, electricity, etc) Rumpler, the German airplane constructor claims to have measured these "secondary fluctuations"—as he calls them—with a fine instrument, and to have found fifteen pulsations per second, or 900 per minute

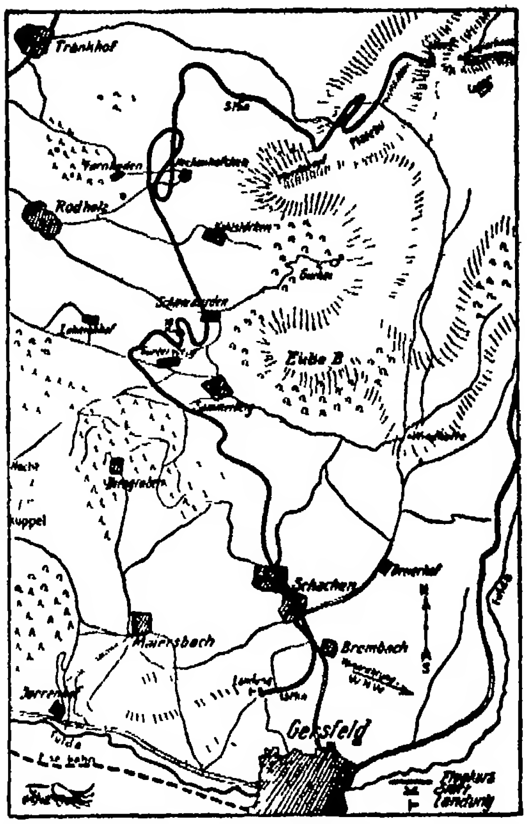
If this statement is borne out by further experiments it is conceivable that these secondary fluctuations are the real source of soaring power, for they may cause the feathers of the bird's wings to vibrate and thus exert propulsive energy Such a means of propulsion would be similar to that obtained with the so-called "fish tail" propellers, whereby the waves of the sea have been experimentally utilized for the production of power This arrangement consists of series of flexible plates which are rigidly attached with their leading edge to the sides of a ship As the waves rise and fall, the plates bend like the tail of a fish, and produce power both on the upward and the downward bend

Requirements of Soaring Machines

So the principal requirements for a good soaring machine become clear This should be a glider, or motorless airplane, having the slowest possible rate of descent, which means an extremely light wing loading (1.5 lbs. to 2 lbs. per square foot at the most), combined with high lift wings It should be noted that a slow rate of descent and a flat gliding angle are not synonymous, for if two machines have the same gliding angle, and one requires a higher flying speed for its sustentation than the other, then the faster machine will naturally descend faster over the same gliding angle

Considering only the assistance of upwinds and gusts for soaring (the utilization of "secondary fluctuations" being at present out of the question) to keep the machine in level flight, the speed of the ascending air current must be equal to the sinking speed, or rate of descent of the machine Hence the smaller the rate of descent, the better chances has the machine of remaining in level flight, or of gaining height through gusts in the manner of soaring birds, and of capitalizing the resultant energy in the lull which succeeds the gust

The question of head resistance has of course an important bearing on the efficiency of soaring machines. At the second German soaring contest held last summer in the Rhön hills, near Frankfurt am Mein, two



Map showing the course followed by Klemperer in his Aachen soarer between the Wasserkuppe and the village of Gersfeld covering a distance of six miles in 13 minutes 3 seconds. In this flight the machine rose 360 feet above its starting point, and it landed 1560 feet below the latter's level. The direction of the wind as well as the elapsed time in minutes, is indicated on this German map

An interesting soaring flight made by a German experimenter

soaring machines, having the same wing area, and one representing the very best in streamlining, and the other quite the opposite, obtained the same rate of descent —*but the streamlined machine carried an additional load of twenty pounds* The soarers referred to are the Aachen and the "Bavaria," which are shown in the accompanying illustrations.

It will be seen that the "Aachen" soarer is a thick wing cantilever monoplane of the type developed by Prof Hugo Junkers of Dessau, which has been introduced in this country under the name of J L metal monoplane The machine is built of plywood in the form of girder work, and is covered with waterproof fabric It is of extremely light weight despite its compact appearance and great strength, the wings weighing only one-third of a pound per square foot of area. The "Bavaria" soarer, on the other hand, has no streamlined fuselage, the tail being connected with the wings by outriggers, while the pilot sits on an underslung seat The general appearance of this machine is reminiscent of the open-body pusher airplanes of some ten years ago. Yet at the second Rhön soaring competition, last August, the "Aachen," piloted by W. Klemperer, and the "Bavaria," piloted by Karl Koller, were tied for first prize in the contest for lowest rate of descent, both making an average of 80 feet per minute. The long distance contest was won by Arthur Martens on a Hannover soarer by covering 4½ miles in 5 min 5 sec His machine follows modern airplane practice in its construction, being well streamlined, but the fuselage is underslung with respect to the wings.

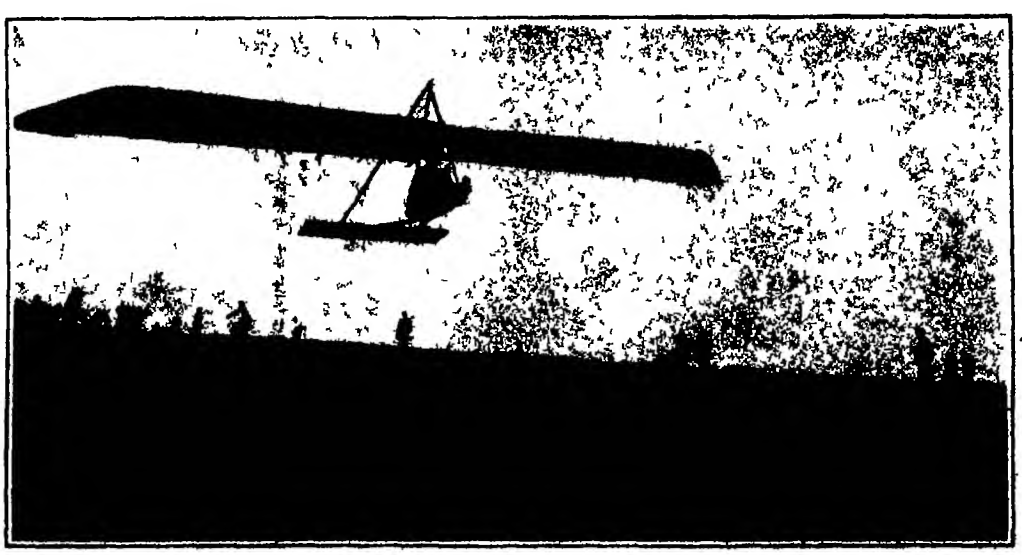
Without going into unessential details of the last Rhön competition, the following points seem worth recording for the guidance of those interested in soaring experiments

1 The competition took place in a country where upwinds and gusts are frequent The machines started from the top of the Wasserkuppe, a hill which rises to an elevation of 3000 feet in a plain bare of trees and free of natural obstacles in all directions. Under these conditions, eminently favorable for soaring, a wind of 18 to 20 m.p.h generally proved sufficient for the purpose but some contestants went up in winds reaching 30 to 40 m p h This, notwithstanding, out of 120 individual flights made there occurred but one fatal accident, and this was due to a structural defect of the machine in question, so that soaring does not seem to involve an unduly large amount of risk as is generally supposed

2. The soaring machines which made the best performance in the different contests all followed straight airplane practice as to structure and control surfaces. The more radical designs all failed to qualify in the elimination trials, which required the pilots to make a gliding flight of at least 1000 feet distance or one of 30 seconds' duration It seems that too many new ideas were embodied in many soarers, so that piloting became very difficult and the machines had no chance of demonstrating what they were actually worth One such machine, the Zeise, was equipped with auxiliary power in the form of small flapping wings which the pilot was supposed to operate by means of two pedals when the wind would be insufficient to keep the machine aloft The principal characteristics as developed by the best German soaring machines are given in the table on page 237

3. For launching the machines into the air two systems were successfully used in connection with the skid landing gear with which the best machines were equipped. If the wind was strong enough for soaring, four men would get hold of the wings and slide the machine along the ground until it lifted—which would generally occur in a few yards. With light winds which would not lift the machines off the ground, the soarer was launched by a sort of catapult from a runway treated with soap to make for easy sliding In this case six or eight men were required. Two of these held the wing tips, while two or three were at each end of a long rope which passed around the rear end of the skids, where it rested in a groove Portions of rubber strands were incorporated in this 'rope," and to launch the machine the men at the ropes walked forward until these strands were fully extended Then at the pilot's signal the men at the wing tips let go, and those at the ropes jumped forward to give the soarer a last pull With this launching device the machine was often in the air after sliding three or four yards, when the rope would automatically detach itself from the skids. Once in the air, the pilot would start climbing in a series of steps corresponding to the wind gusts.

4 Most of the breakage occurred at the first trial of the various machines, partly because of the unfamiliarity of the "handling party," but chiefly owing to faulty construction of the landing skids. The experience of the Germans shows the importance of giving the skids a parabolic form so as to enable the pilot to "pull up' the machine as soon as a gust hits it, and so derive from it maximum lift. If the gust is very violent, a soaring machine can thus take off without outside as-



The soaring machine of the Bavarian Aero Club, which is fitted with variable incidence wings, being piloted by Karl Koller

distance. With machines on which the incidence of the wings can be changed by the pilot (the Bavaria soarer, for instance) the use of curved skids is less important

Some Remarkable Soaring Flights

As a conclusion to this review of progress in artificial soaring flight the most remarkable performances which have been made to date will be related. All of these occurred after the second Rhön competition.

On July 30 Klemperer (Aachen soarer) flew across country from the Wasserkuppe to the village of Gersfeld, covering a distance of 6 miles in 18 minutes 3 seconds. In this flight the machine rose *800 feet above its starting point*, and it landed 1500 feet below the latter's level The accompanying map shows to what extent the pilot was able to control the flight of his machine, making clever use of the upwinds impinging against the hillsides.

On September 6 Martens (Hannover soarer) beat Klemperer's record by making a duration flight of 15 minutes 40 seconds from the Wasserkuppe to the village of Botten, a distance of 4.6 miles. This gives a rate of descent of 84 feet per minute as against 119 feet for Klemperer's previous flight

While these performances strongly appeal to the imagination, it is none the less a fact that considering the rate of descent of the machine in question, their performances cannot be considered as true soaring flights, but merely as very extended glides, the more so as each flight took place in one general direction. Hence a certain amount of doubt was justified with regard to the possibility of achieving true soaring flight with the available type of machine

This doubt is, however, no longer warranted, since on September 13th, 1921, Herr Harth, an investigator of soaring of ten years' experience, succeeded in making a flight of 21 minutes 37 seconds' duration with a difference in height between his starting and landing points of only 40 feet, which gives *a rate of descent of less than two feet per minute* This truly amazing performance, which did not receive the world wide attention it deserved, is an undeniable demonstration of the fact that soaring flight can be achieved with the present aeronautical equipment In other words, soaring is possible without the mechanism that would have to be invented to reproduce the vibration of the bird's feathers under the influence of the secondary fluctuation of the air—always assuming that this phenomenon is the main source of energy of the bird's soaring flight

While no photograph of Harth's soarer has yet been published, a general idea of what it looks like may be had from the following particulars The machine is a monoplane of 33-foot span and 165-foot wing area, and weighs 100 pounds. The pilot is seated underneath the wings in a lattice framework which extends aft and carries the tail The latter consists of an elevator only, for the rudder which was originally fitted to it has since been dispensed with, as the machine was found to be more manoeuverable without it Instead, changes in horizontal direction are effected by the use of movable wing tips.

Harth's partner in soaring enterprise, W Messerschmitt, has given the following account of Harth's great flight:

"On the day of the flight, September 13th, the wind was blowing in strong gusts with frequent changes in direction at an average speed of 22 miles an hour, which would at times suddenly increase with hurricane force to twice that strength Heidelstein Hill, from which the start was made, reaches 2725 feet above sea level, but the slope of the hill to windward is only two or three degrees above the horizon, followed by slightly steeper slopes (four to six degrees), which in their turn end in a flat plain extending for several miles, after which there occurs again a very flat slope.

"Harth first made a few flights up to six minutes' duration *without any loss in altitude*, and as the wind strengthened he decided to attempt a much longer flight, and reach, if possible, greater heights than before At the same time he saw the feasibility of letting the machine rise into the air without outside assistance, merely by utilizing the strong gusts. This he succeeded in doing, and once off the ground he began climbing into the wind until he reached a height of 200 feet He then made a half turn and flew with the wind back over his starting point, whence he flew a circular course all around the hilltop, then out over the lowlands. After a while he turned about and flew back over the hill, and describing two half turns in opposite direction he landed 40 feet below and about 500 feet from his starting point

"As the flight was made over practically level country, Harth is of the opinion that ascending air currents had nothing to do with it, and that he actually soared with the help of the wind fluctuations. He noticed by the way, that the speed of his machine varied considerably when it flew against the wind, and that it always rose on turns, while it did not seem to lose any altitude when flying with the wind. He also states that the machine *remained perfectly steady* in the midst of gusts, and he attributes this fact to the use of movable wing tips which are made to head automatically into the wind and so keep the machine on its flight path"

Messerschmitt's concluding paragraph is perhaps worth reproducing It reads

"Our object, motorless flight of sufficient duration seems now to have been attained. Messrs. Harth and Messerschmitt have for the last ten years made systematic experiments with wing surfaces capable of automatically turning into the wind *(anpassungsfaehige Tragflaechen)* The results recently achieved prove that there exists now a soaring machine which can easily be *flown for any length of time* in the most squally weather without requiring from the pilot any physical effort."

Copyright, Kadel & Herbert

The Aachen soarer, piloted by W Klemperer, shortly after its "take-off"

CHARACTERISTICS OF THE LEADING GERMAN SOARING MACHINES

Make	Span	Length	Wing Area Sq Ft	Wt. Empty Lbs	Wing Loading Lbs to Sq Ft
Aachen	30' 8"	19' 9"	162	143	1.87
Bavaria	30' 4"	13' 3"	162	123	1.74
Hannover	41' 0"	17' 2"	172		
Harth	33		165	100	1.57

Note—The wing loading given above refers to the machine fully loaded that is, with the pilot on board. The weight of the pilot is assumed as being 160 pounds.

For purposes of reference it is interesting to compare the characteristics of the German soaring machines with the *aviette* on which Gabriel Poulain twice flew a distance of 33 feet (in opposite directions) on July 9, 1921, near Paris. This machine was a very light bicycle which was fitted with a biplane cell of 20 feet span on the upper wings, and 13 feet 4 inches on the lower wings, and having a wing area of 190 square feet. The net weight of the Poulain *aviette* was 37.4 pounds, and its maximum flying speed was estimated at 25 miles per hour The wing loading, with a 160-pound pilot, works out as 15.1 pounds to the square foot, or about 10 times that of the Harth soaring machine

The Significance of Harth's Flight

Although the latest advice from Germany is to the effect that Harth was unfortunately injured in a fall of his soarer, this accident does not in the least decrease the value of his truly extraordinary demonstration No doubt even Harth's soaring machine is still far from perfect, and a considerable amount of experimenting will have to be done before soarers become fool proof

In the meantime, here is a field of practically unexplored human activity which offers a chance of turning flying into a real sport, one comparable, though on an infinitely superior plane, to sailing Individual skill *and prowess could assert themselves in soaring to an* extent undreamed of in power flight where, after all the roaring Liberty or its hissing minor brothers always have the last word

What the practical advent of soaring will eventually mean to power flight is still a matter for speculation That it will lead to a more thorough knowledge of the atmosphere and so be the cause of improvements in the construction of airplanes, seems likely It may perhaps also improve our notions of piloting Finally, it is probable that vastly improved soaring machines fitted with an auxiliary engine of very low horsepower will eventually solve the problem of the aerial flivver They won't be extremely fast but they will be cheap and economical and so within the means of anybody who can afford to keep a Ford And they will carry you anywhere without the hazard of getting stuck in a jam at cross-roads or of running into a ditch on a dark night

Here is an opportunity for Americans to do some pioneering work Will someone heed the call?

Biological Effects of the Tides

FRINGING every continental land-mass is an area for the most part very narrow which belongs properly neither to land nor sea, but is the disputed province of both these realms Although, on a superficial view it is by no means favorable to life the tidal zone turns out, on closer examination to be one of the richest in variety of animal life on the surface of the globe

Whether life began in the open sea or in the shallow waters of the littoral or in fresh water pools, scientists have not been able to decide Nevertheless, one thing is certain namely that if life did not originate in the tidal zone nor in the area immediately below it as some still think possible then life was not very long in reaching there It is unnecessary to adduce special proof of this statement the vast number of invertebrate animals that frequent or have frequented or that have relatives on the shore, from sponges, through coelenterates echinoderms, worms, crustaceans, and mollusks up to ascidians allows of no other conclusion In its earlier youth, then life served an apprenticeship to the tides, and it is probably not too much to say that life is continuing to show the effects That is what biologists intend to express when they speak of the shore as the school wherein many of the most important lessons of life were learned

As illustrating this there is the influence of wave-impact on the life of the sea shore This is at once made apparent to the observer not only by the large number of fixed forms of which the rock barnacle is a prominent example, but also by the tendency even among free animals to keep *a grip on the substratum* The adhesion of barnacles is due to a cement substance secreted by special glands in the region of the head but in the case of sea anemones flat worms sea slugs and sea snails, adhesion is due merely to an exceedingly close contact of the body with the substratum A very interesting adaptation to life in the area of wave-action is seen in a fish called the lump-sucker, which has the pelvic fins converted into a cup, or sucker, with which it clings to rocks and weeds Mere adhesive powers are, apparently, not sufficient, since there is a tendency also to adopt a form which offers the least possible amount of resistance to the water, and, in particular, to reduce height. Shore forms are typically flattened forms.

The conclusion must be reached that the tides have not only been of very great importance in molding the present day life of the seashore, but have also had far-reaching consequences to life in general. This pulsing ever-changing strip of the earth's surface has played a part in life out of all proportion to its size.

Our Point of View

Invention the Master-Key to Civilization

SHALL we be very far wrong if we place the inventor at the top of the list of men and things that have made the civilization of today what it is? Personally, we do not for one moment hesitate to do so. And this does not mean that we fail to recognize how much humanity owes to science, medicine, philosophy, finance, morals, and religion, which, by utilizing the works of the inventor, have made them conduce as much to the mental and moral as to the physical wellbeing of mankind.

Let your thought travel back to prehistoric times, to the day when man, possessing only the faintest glimmerings of intellect, had little more than hand and foot and teeth with which to compete with the beasts of the forest, most of which had more of speed and strength and cunning than he. What was it that started him on his upward climb to superiority but the use of his dawning intellect in the invention of weapons with which to turn this unequal conflict in his favor? One of the earliest great inventions, if not the very first, took place when someone cut a strip of tough skin, strung it tautly between the ends of an elastic stick, and fashioned the first sharp-pointed arrow as a missile. Thereby did invention overcome brute strength, and thenceforth, by similar applications of reasoned thought to the substance and properties of things, has man progressed in building up the complex and altogether marvelous civilization of our day.

If the importance of a man is to be judged by the extent and duration of his achievements, it cannot be denied that, in the presence of our old friend the inventor, all the kings, princes, emperors, statesmen, and soldiers of history, sink into relative insignificance.

Not to Alexander, or Cæsar, or Charlemagne—not to Aristotle, Cicero, Dante, or even the great Shakespeare—not to a Talleyrand, a William Pitt, a Cavour, a Gladstone, a Jefferson, or a Webster—not to the long line of brilliant men who have graced the law and the church—not to these do we owe the locomotive, the steamship, the automobile, and the fast flying ships of the air, agencies which have unlocked the immobility of man and made fluent the age-long solidity of the world. Not to these men, who are writ so large on the page of history do we owe the printing press, the telephone, the telegraph, the wireless, and all those means by which no sooner do the thoughts of men germinate than they are flashed around the world—not to these men, but to real, honest-to-goodness, imaginative, painstaking inventors, such as Guttenberg, Faraday, Newcomen, Watt, Symonds, Fulton, Stephenson, Morse, Marconi, Pasteur, Edison, Langley, Wright, and a thousand others, who have always stood, and ever will stand, in the very van of the advancing hosts of civilization.

Now, this is a fascinating theme, and it has lately been handled most delightfully by one of the inventors of America, a man who has done as much, as an inventor, in the development of the United States Navy as any single man of whom we know. We refer to a book which has just been placed in our hands, entitled, "Invention the Master-Key to Progress," which has been written by Rear Admiral Bradley A. Fiske, who, in sending us a copy of his book, asks us if it does not "demonstrate that the whole structure of civilization is a machine, built up by inventors." We think that, with due acknowledgment of the important cooperation of science, religion and discovery, the statement of Admiral Fiske is essentially true.

Moral of the Washington Theater Tragedy

A FEW weeks ago the roof of a theater which was being built in Brooklyn fell, killing a score of workmen. More recently the roof of an important theater in the city of Washington fell, causing the death of ninety-eight people, including many well-known residents of that city. In both cases these horrible disasters seem, so far as the evidence has gone, to have been due to a combination of faulty design and careless inspection. We are free to confess that, so far from being astonished at disasters of this kind, we have been surprised that they were so long in coming, and that more have not happened. They are the logical and inevitable outcome of certain modern conditions, the perils of which should be shouted from the housetops, for the warning of that unsuspecting public which, as these ghastly tragedies have shown, may at any moment become the victims of the conditions.

We refer to the constant stream of so-called qualified architects and engineers, which issues yearly from our technical institutions, the members of which, equipped with no practical field experience, and furnished with nothing more substantial than the formulas and theories contained in their notebooks, proceed to hang out their shingles, and thereby advertise themselves as competent in their various professions.

Let it be understood right here, and very clearly, that we do not refer, specifically, to the authors of these wrecked structures, for we have no wish to prejudge their cases, we are casting no, nor would we cast any, aspersion upon the great body of engineers and architects taken as a whole, among whom are men as gifted and as well informed as to the past and present of their art, as any of the notable men who have made these professions famous. Our strictures are confined to the half-baked beginners, who, instead of associating themselves in a subordinate capacity with their seniors of ripened experience, hire a desk and open an office, and so proclaim themselves competent to undertake any job whatsoever from the building of a Hudson River bridge to the erection of a Woolworth Tower.

Now, what has been taking place in the professions has happened also in the various trades having to do with heavy construction, and notably in the art of building. Today, any ambitious young carpenter, mason, or ironworker, growing scornful of the weekly pay envelope, is free to break away and set up as a master-builder. Some of these are men of real competence and ultimately make good, the majority of them were never gifted by the Creator with the resourcefulness, breadth of view, experience or executive ability, which are necessary to make a really competent contractor. However, there they are, and they are out to get contracts. What is the result? We have on the one hand the ambitious young architect, anxious to secure enough to pay for board, clothes, and office rent, and, on the other hand, we have the mechanic, now dignified with the title of contractor, who simply has to get contracts by hook or by crook, or suffer the humiliation of going back to the régime of the weekly pay envelope.

Well, human nature is sometimes very fine, sometimes very bad, and more often somewhere between the extremes, but the temptation on the part of the embryo architect is to skin down his construction as closely as he dares to the limit of safety, and the temptation for the young contractor is to beat the plans, by still further reducing the weight of material and the quality of construction that goes into the job.

That the above statement of conditions is not overdrawn is proved by the amazing evidence given by five army and navy engineers at the coroner's inquest into the Washington theater disaster, who found no less than twenty-one evidences of weakness in the structure.

Thus, *tile walls* according to the Washington dispatches were used to carry a heavy concentrated load. Just think of that! There was no column to receive the load, nor was there even a pilaster where the main truss rested upon the wall. Apparently this tiling was left hollow, for there was "an absence of concrete fill" at the point of bearing, and there were no bearing plates on the wall. The steel, we are told, was insufficiently anchored to the wall. Finally, not only was the tile not hard burned, but it had scant webs and walls, notably at the top of Columbia Road wall, where the collapse took place. Moreover, in this wall there was insufficient bonding between the front and back tiles. If these findings are correct, it is little wonder that the additional snow load brought down such a wretched contraption.

Orphans of the Road

THERE are always two viewpoints with regard to changes in the design of an established product. On the one hand we have the man who is always striving for something better—even if it be but a little bit better. Opposing him we have the conservative who holds that changes should come slowly, and only after they have proven themselves conclusively. In practice the latter view is backed by the exigencies of manufacture, a million dollars' worth of factory machinery cannot be scrapped in the interest of a thousand-dollar improvement in the product.

For several years we have assumed the automobile industry to be in this conservative class. We look to the makers of our cars and trucks for gradual shifting of design rather than wholesale reversal of opinion. For we had supposed that, save for grudging accommodation to new conditions like fuel deterioration, the modern automobile was pretty much a finished product, not susceptible to sweeping changes.

It is with mingled emotions that we pass from these considerations to a recent announcement detailing the "improvements" in a certain car for 1922. Without being too specific, we can say that these involve, among other things, radical changes in the lubrication, the carburetor, the intake manifold, the radiator, the fan belt, the clutch, the torque member, the braking, the gear ratio, the springs, the rear axle, the front spindles, the steering gear, the frame, the body, and the fender.

Our first impulse on reading this catalog of "betterments" was to look up the concern and see how long it had been making automobiles. It would seem that in the six years of their corporate life, these gentlemen might at least have decided what kind of car they want to make. The tale of their "improvements" for 1922 is told with gusto, apparently in the hope of impressing the reader with the atmosphere of progress. We wonder just what the owner of last year's model will think when he learns the extent to which his car has been reduced, overnight, to a bundle of obsolescent junk. Shall we picture the plight of the service station that tries to keep a complete line of parts for all models, and to identify the particular one needed for inclusion in the repair of a 1919 specimen, or shall we infer that the service station will frankly leave the owner of such a car marooned, and tell him, as so often is done, that they can't be bothered with his job?

The thing has its humorous side which cannot be ignored, it has also its serious side. Everybody will agree that among the hundreds of cars on the market, there are and always have been a dozen or perhaps a score that stand out above their competitors as the cars to own. There might be controversy regarding the make-up of this group, of its existence there can be, we think, none.

Is not the reason for the persistence of this class of old reliables the fact that, with very minor modifications, these cars are the same, year after year? The ability to get a car right in the first place—the balance to keep it right thereafter—are not these the things that give us confidence in designer and builder? The production, every twelve months or every two or three years, of a model which can be recognized only by the nameplate as the successor of its predecessor, this was good automobile designing fifteen, even ten, years ago. Today it is a confession of weakness.

The fact that a given car enjoys an abnormally slow depreciation in turnover value, the fact that used models five and even ten years old command an active market, means an actual saving in dollars and cents to the buyer of such a car when he comes, at some future date, to trade it in. The practice of other makers, of admitting more or less candidly in their advertising matter

Our Point of View

and in the chatter of their agents that previous models have carried serious weaknesses, or have been of poor caliber throughout, but that *this* year's car is the one they are selling *now*—this leads to equally strong presumption that such saving will be absent when the time comes to dispose of a car of this sort. But far more important to the user than any specific saving is the knowledge that, under a verdict rendered by the automobiling world, his car will be current and serviceable and repairable after a long period of use, while the other fellow's will in a year or two suffer from the presumption of obsolescence, present questionable serviceability, and pretty certainly be repairable only at excessive cost and extreme inconvenience.

A Call for Cooperation

If ever there was a call for close cooperation in the solution of a great and difficult problem, it is in the matter of reorganizing the transportation and terminal facilities at New York. As the traffic through the port has increased, the problem of properly handling it has loomed up year after year, with ever growing importance. Unhappily, the city fathers (and this means Jersey City just as much as Manhattan and Brooklyn) never realized that such provisions in the way of piers, warehouses, handling machinery, railroads, and so forth, as they were from time to time providing, were in the last analysis merely make-shifts, destined sooner or later, and rather sooner than later, to become obsolete and unequal to the task imposed upon them.

More serious than this, however, was the failure of the city fathers to appreciate the vast magnitude of the problems of the future. They failed to see that the time was swiftly approaching when, if the mighty flood of traffic which was destined to pour through the port of New York, was to be properly controlled, it would be necessary for all the interests served by the port of New York to get together and formulate a program of action which should be marked by foresight, directness and above all by unity of spirit and purpose

It was in tardy recognition of these facts that the states of New York and New Jersey finally did get together and form what is now known as the Port Authority, and gave it instructions to gather all available statistics, and employ the best engineering and financial talent to formulate a plan covering the total situation. This has been done and the plans have been published and very widely discussed.

Briefly stated, the port plan seeks to link up all the railroads which enter New York City by means of a belt line which shall touch every one of them, and enable freight that comes over any western or other road, to be switched on to the belt line and carried directly to that part of the port where the consignee—ship, factory, market, or merchant—may happen to be located. The proposed Port Authority belt line extends, on the Jersey side, parallel to the Hudson River, and about a mile distant therefrom, and extends by tunnel below the upper bay to a junction with the Long Island railroad system in South Brooklyn. The Long Island and the New York Connecting Railroad continue the belt line through Brooklyn and across the East River by the Hell Gate Bridge, to and through the Bronx, reaching the Hudson River again at Spuyten Duyvil. To serve Staten Island, the belt line will utilize the route of the Central Railroad and the Baltimore & Ohio over which, by means of the bridge across the Arthur Kill, the system will reach the new city docks at Stapleton, Staten Island.

Now, the existing city government, under its present redoubtable Mayor, professes to be very much disgruntled with the Port Authority plan. The Mayor believes, or professes to believe, that the Port Authority plan is merely a gigantic political scheme to "develop the Jersey meadows," or do some other malevolent things for the benefit of New Jersey and to the detriment of New York City. Personally, we do not believe anything of the kind; and we are convinced that any intelligent person who looks at the city plan and the Port Authority plan will feel that any suggestion of ulterior purposes of this kind is altogether uncalled for, being without a shadow of foundation in fact.

The readers of the Scientific American have already been made acquainted with the city plan, in an article published in the Scientific American for January, and written by Colonel William J Wilgus, Consulting Engineer of the Board of Estimate and Apportionment. This plan, it will be remembered, differs from the city plan mainly in two things, first that the belt line starts on the Jersey side not far from Piermont on the Hudson River and intersects the incoming western railroads at distances of from ten to twenty-five miles from the waterfront. The line sweeps through New Jersey, finally reaching Perth Amboy, where Arthur Kill is crossed on a high level viaduct. Thence the belt line passes through Staten Island, on which a large classification yard is to be located. It serves the city's new piers at Stapleton, and then tunnels beneath the narrows to a connection with the Long Island and connecting railroads, thus forming a complete belt line.

Manifestly the sensible thing for the Mayor and his associates to do is to cooperate with the Port Authority, abandon its campaign of innuendo and obstruction, and set about honestly to to work with the states of New York and New Jersey for the benefit, not of its own political aspirations, but of the eight millions of people in the Port District whose combined interests it should be the highest object of the Mayor to serve

Fruits of the Safety-First Movement

We are told by the Interstate Commerce Commission that not since the year 1898 have there been so few railroad fatalities in the United States as were recorded in the year which closed December 31, 1920, the last year for which statistics have been compiled. Had this fine record been made during a period of railroad prosperity, when funds were plentiful and materials and labor reasonable in cost, it would have called for strong approval, but the year 1920 was one of the utmost heartbreaking discouragement for the railroad management, in which the most drastic economies had to be practiced. Not only did high wages render it necessary to work the railroads with depleted forces, but the high cost of materials necessitated postponement of orders for rails, ties, ballast, and other materials that were sadly needed to keep the railroads in first-class condition.

The number of persons killed on our railroads in 1898 was 6859, and the number injured was 40,882. In 1914 the number killed was 10,302, the number injured 192,662. In 1920 the total had dropped to 6958 killed and 168,308 injured. Now to appreciate the full meaning of this record, it must be understood that between 1898 and 1920 the passenger mileage increased from 13,000,000,000 to 47,000,000,000, or over 250 per cent, and there was an increase in the number of employes from 874,558 to 2,074,971, or 160 per cent.

In analyzing the tables given by the Interstate Commerce Commission many interesting facts are developed. Thus, of the total of 6958 killed during 1920 nearly one-half were trespassers on the railroad tracks, a fruitful and altogether unnecessary source of loss of life. Of such over 4000 were killed. The next largest figure is that for employees, of whom 2578 were killed. The majority of these losses occurred in freight traffic, and that they are so large is to be attributed too often to the independence of the employees and their lack of a strict sense of discipline. In these days of automatic brakes and automatic couplers and the activity of the Safety-First Movement, the fatalities to employees should be very much less than they are. The total number of passengers killed was 229, of which 76 were lost in train accidents, and 153 in train service accidents. It should be noted that the fatalities to passengers were about the same in 1920 as they were twenty-two years before, but the record is much better than it looks on the face of it, for we must remember that passenger traffic has increased in that period 254 per cent, similarly, although the number of employees increased 160 per cent, the fatalities increased less than 32 per cent.

Referring again to passenger fatalities, it is notable that only five times in the thirty-five years covered by the statistics of accidents were there fewer fatalities of this kind. In spite of the struggle which the rail roads passed through in the endeavor to cover expenses, taxes, and rent, they carried over 47 000,000,000 passengers one mile with only 76 fatalities in train accidents. To put it another way, over 622,000,000 passengers were carried safely one mile, to one killed.

If the above figures fail to convince anyone that railroad travel has become a very safe means of transportation, let him consider the following fact that 296 railroads, which embody nearly one-half of the total mileage of the United States, operated throughout the year 1920 without the loss of a single passenger

The 1921 Naval Annuals

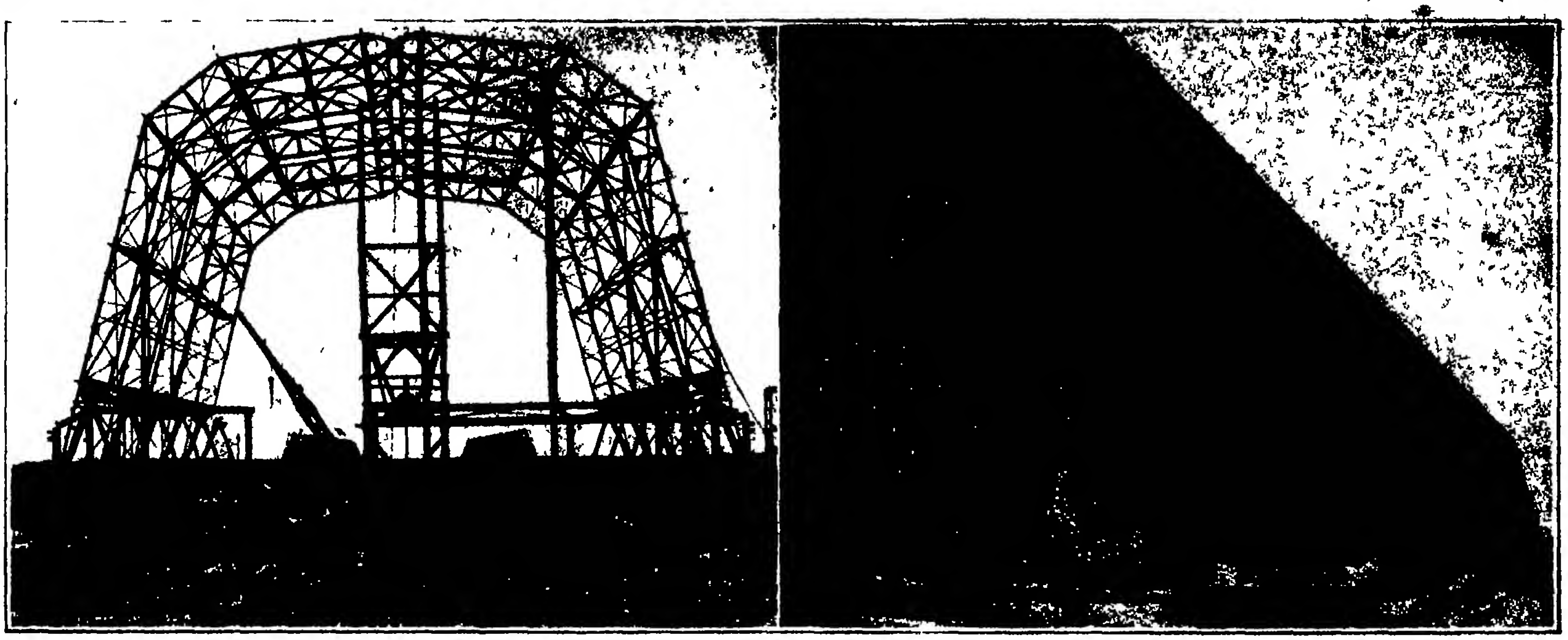
To a naval man the names "Jane" and "Brassey" are as familiar as the terms "wind" and "weather" The Annuals bearing these names are sources of naval information which have become indispensable to the naval man and to the thousands of laymen who take an intelligent and patriotic interest in the Navy and Merchant Marine The latest editions of these works, covering the year 1921, are larger and more packed with carefully selected facts and figures than any of the preceding volumes.

The new "Brassey" includes all the characteristic features of the earlier volumes, such as the detailed tables of the ships of the various Navies, the admirable line cuts of the principal types of ships, and the Ordnance tables. A large part of the work consists, as of old, of articles written by leading experts in their particular fields, but the list of these is now greatly extended, and they contain a mass of carefully digested and up-to-date information, representing the latest school of thought on the various questions discussed The excellent plan, instituted last year, of including a section on the Merchant Marine, is continued, and this part of the Annual is fully up to the quality of the Naval section.

Although it is a younger publication, "Jane's Fighting Ships" is an even more voluminous work than the other, and as much as 635 pages, measuring eight by twelve inches, are required for the presentation of all the engravings, tables, and various data "Jane" contains some features which are absent from "Brassey" just as "Brassey" is stronger in let us say, the fine series of articles by technical experts referred to above Special features in "Jane" are the pages of silhouettes, by which any ship of any navy may be recognized, and the very valuable series of scale maps showing the dockyards, and principal harbors of the naval powers.

The bulk of the work, as usual, consists in detailed illustrations and descriptions of every ship of importance in the navies of the world. This information includes the particulars as to displacement, armor, armament, speed, etc., an outboard profile and a deck plan, showing the armor and armament, and one or more photographic reproductions of each ship. The airplane views of ships, which are shown very freely, will be valued for the information they convey regarding the deck, superstructure and bridge arrangements of the capital ships that are thus portrayed.

Particular interest attaches to these latest issues of the now famous Annuals because of the fact that they will constitute a last record of the stupendous size to which navies, and particularly the capital ships of navies, had grown under the competitive system The Annuals for the next year doubtless will contain the famous Disarmament Treaty, and will show in their pages what a drastic reduction it has made in the size and cost of modern navies.



Left: Re-erecting steel framework of old hangars upon side wall of A-frames to form new and loftier hangar. *Right:* New hangar completed, showing portion of front sliding doors and one side. Total length, 710 feet

Making Two Dirigible Sheds into One

THE growth in the size of dirigibles rendered some of the earlier hangars too small for their accommodation. This was the case with two identical hangars located respectively at Montauk, N. Y., and Cape May, N. J. Each of these was 250 feet in length and 72 feet 6 inches in height. The framework consisted of three-hinged, framed steel arches of 122 feet 3½ inches span, which were spaced 20 feet 10 inches apart from center to center.

The Navy Department decided to take down these two hangars and use the materials in constructing a larger shed, which would have the same width of 122 feet 3½ inches between end pins, a width over all of 156 feet, a height of 110 feet clear at the entrance, and a length of 710 feet.

The two hangars were taken down, the steel work of the Montauk hangar being shipped to Cape May. To obtain the desired height two parallel lines of steel A frames were erected for the full length of the new hangar, and upon these frames was erected the steel work of the two dismantled hangars. At one end the hangar is closed by sliding doors, and at the other end a lean-to 16 feet by 22 feet extends the full width of the hangar.

As showing the economy which has been realized by this system, it may be mentioned that each of the old hangars contained about 350 tons of steel, and of this 284 tons from one hangar and 238 tons from the other were utilized in the larger structure.

The A frame bents, which are 44 feet in height, rest upon reinforced concrete foundations, which are carried upon wood piling. Two parallel rails, 90 feet between centers, extend through the full length of the hangar and extend out 1000 feet into the landing field. Between these rails run the trolleys which are used for guiding the airship from the landing field into the shed.

The building is sheathed externally with asbestos shingles laid upon wood planking. The lofty sliding doors are covered with corrugated asbestos. The doors slide laterally upon steel tracks, and they are stiffened and held in the vertical position by the inclined steel framework, which is shown very clearly in our engravings.

With the completion of the Cape May hangar, the Navy Department now possesses two dirigible sheds available capable of accommodating the largest airships. The other is the new shed at Lakehurst, which has been already described in the SCIENTIFIC AMERICAN. For our information and photographs we are indebted to Rear-Admiral F. R. Harris, Public Works officer at League Island. The hangar was built for the Navy by the Bureau of Yards and Docks, and the field work was in charge of Lieutenant-Commander J. N. Laycock, U. S. N.

Four-Footed Transatlantic Passengers

HOW many people realize that the service in ocean travel so admirably rendered to men, women and children by a great steamship company like the Atlantic Transport Line, the American Line, the Red Star Line, the White Star Line and Leyland Line is duplicated in essential features for four-footed passengers as well?

Each of the lines mentioned has special facilities for taking our four-footed friends on ocean voyages so that horses, pet stock, cattle or other live stock are just as readily transported by steamer as human beings, while the matter of obtaining bookings for your favorite horse, or for a consignment of horses or other animals, is no more difficult than making a reservation for yourself and your family.

It is not to be assumed however that the four-footed travelers make their ocean voyages in the same ship as yourself. They have ships of their own as carefully fitted up to meet their needs as your ship is to meet yours.

Ships known as live-stock carriers are specially built for that purpose. First of all, they must be big, broad ships that will ride steadily in the sea, with minimum rolling, for "sea legs" are not easily acquired by four footed passengers.

The ship specializing in the carrying of animals must also be fitted with specially designed and constructed stalls for horses, special pens for cattle, and so on, the comfort and safety of each kind of stock calling for a certain type of equipment.

Further, the liner for four-footed passengers must have facilities for special ventilation. Our four-footed friends are used to outdoor life, and to freely ventilated stables or barns. It would not do to shut them up in a dark, poorly ventilated space at sea.

Again risk of injury must be avoided when the four-footed passengers go on board the ship or leave it. Hence large side ports, like great swinging doors, are built in the sides of the live-stock liner, from which ample gangways can be fixed, enabling the stock to walk on or off the ship on a gentle grade, without risk of stumbling. The great hazard of injury attending the old hoisting method of handling cattle is entirely avoided in the modern live-stock ship.

It is quite obvious that the successful live-stock steamer, owing to the requirement of stability, must be of the freighter type, with enough reserve power to bring the ship and her valuable cargo safely through all sorts and conditions of weather.

A visit to one of those live-stock steamers will surprise a person not familiar with their facilities for shipping live-stock overseas.

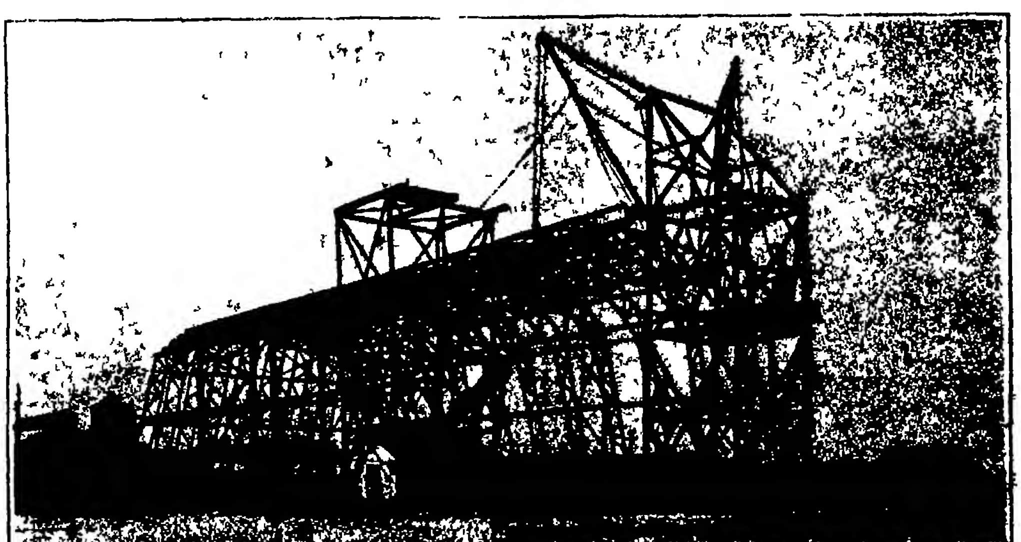
Entering by way of the specially constructed gangway or "brow," leading from the pier to the steamer, one passes through a large cattle port and steps directly upon the live-stock deck of the steamer.

The first impression received is one of amazement at the cleanly spaciousness of the place, the absence of obstructions and the presence of an abundance of pure fresh air circulating systematically through the entire length and breadth of the steamer.

Here will be found any sort of live-stock accommodation which may be desired—horse fittings ranging from the 2-foot 6-inch stalls for commercial horses to the 10-foot padded box stalls occupied by the aristocrats of the equine world, also hundreds of 10-foot cattle pens, all neatly whitewashed and each designed to take care of four animals.

Overhead will be found the fresh water supply system, with hose connections and water tanks at regular intervals along the deck. Under foot there are numerous scuppers to insure the perfect drainage so necessary to the comfort of the animals. Peat moss and sweet straw are used for bedding.

Electric lights are installed throughout, and the effect of the whole is that of a large, well-kept, up-to-date stable.



Dismantling old hangar. The frames of this and a similar hangar at Montauk were used in building the roof of new 710-foot hangar at Cape May

A Pump-Power Railroad

How Gravity, Through Water-Filled Tanks, Draws Passengers Up a German Mountain

By Andrew Goobeck

SITUATED on the left banks of the historical Rhine where the American soldier has been walking post since the signing of the armistice, 18 kilometers from Coblenz, the headquarters of the American Forces in Germany, lies Andernach, the second oldest city in Germany and the oldest on the Rhine. Founded in the days of the Romans about 12 B. C., it was one of the 50 forts built by Drusus along the river and the headquarters of the 21st Roman Legion, with ruins of the old walls still partly surrounding the city, which today is the headquarters of the Second Brigade of the American Forces in Germany.

Towering above the lower outskirts of the city and the river is a small, sheer mountain known as the Khranenberg, on whose steep incline is a narrow gage railway, built in 1805 by a private concern and successfully operated until the late European war broke out, causing it to remain idle until this year, when the city of Andernach acquired the management and is now running cars on schedule to Khranenberg Summit.

The railway, built to accommodate tourists and pleasure seekers, is about 550 meters long from the city to Summit Station, which is 120 meters above the former, the steepest part of the climb being midway where the rise in grade is one meter to every three meters of track. The mechanical operation of the tramway is very simple and economical. The rolling stock consists of two cars 8½ meters long by 3 meters wide, weighing 7 tons apiece. These are connected to each other by a 1¼-inch woven wire steel cable, which passes over a 10-foot-diameter iron guide-wheel underneath the platform of the Summit Station. One car stands at the summit when the other is at rest at the city station. Both the cars are fitted with a tank underneath the rear platform holding 6¼ cubic meters of water and a glass gage alongside the rear of the car, spaced off in half-meter lengths to show the amount of water in the tank. Through a small manhole in the front of the car and a water spout on the station platform, water is taken by the car at the summit a few moments before departure, the amount taken depending upon the number of passengers in the car leaving the city. There is telephone communication between the two stations, installed for this purpose and for any other communication between the two operators of the two cars, who constitute the entire transportation department. A few moments before the time of departure, the guard on the up-going car calls the guard of the down-coming car, standing at the summit and tells him the number of passengers in his car. The man at the top of the line, having already counted the passengers in his own car, opens the valve on the water spout and takes the amount of water necessary to give the additional weight that will pull the up-coming car to the summit. The water in the down-coming car tank is automatically released the moment the car stops at the City Station, through two valves located underneath the tanks which come in contact with interference plates placed above the track. When both cars are empty 3¼ cubic meters of water are required by the car at the summit to pull the empty car coming up. Each car has seating capacity for 24 persons and standing room on the platforms for 11. In event of a fully laden car departing for the summit and no passengers in the down-coming car, 6¼ cubic meters of water are more than sufficient to make the trip. There are no springs between the body of the car and the frames, and what little shock may arise from the slow trip which consumes 6 to 8 minutes, is absorbed by hard rubber pads laid between the frame and body.

The cars are equipped with both service and emergency brakes. The latter may be operated from either end of the car by a simple rotary brake-rod operating a worm gear through a gear block, which through the brake levers applies the brakes to both cog wheel drums underneath the car.

The railway is of one-meter gage and single track, with a passing siding located in the middle of its course and is supported by iron ties in a rock bed which gives it a firm and solid foundation, the outside and cog rails being firmly bolted to the iron ties. The middle, or cog rail, which is used to give the cars brake resistance, is laid in short 2½ meter lengths in order that worn sections may be removed in short lengths.

The cog rail is of peculiar design its cogs being about one inch below the double-flange girders on each side. This design aids in keeping the car on the track as well as furnishing resistance for braking. On each side of the cog rail and between the outer rails, about seven meters apart, are small guide pulley wheels over which the cable runs that is attached to the two cars, the cable of one car running over the right guide wheels, and the cable of the other car over the left guide wheels. The passing track being located at the middle of the course, the car with the right hand cable takes its respective track and the car with the left-hand cable takes the left track, this being accomplished by the peculiar construction of the car wheels and their opposite arrangement on the two cars.

The car with the right hand cable and which has to take the right passing track is equipped with double-flange wheels on the right side and plain or Mulley wheels on the left side, while the car wheels on the car with the left hand cable are just the reverse, having double flange wheels on the left side and Mulley wheels on the right. The outer rails of the passing siding being unbroken, each car is guided to its respective side while the Mulley wheels pass over the inside rails and unbroken cog rail without any interference, as the wheels are rigid on their axles and run through very strong housings in the frame. The cog rail of course has to remain unbroken, or otherwise brake power resistance would be lost.

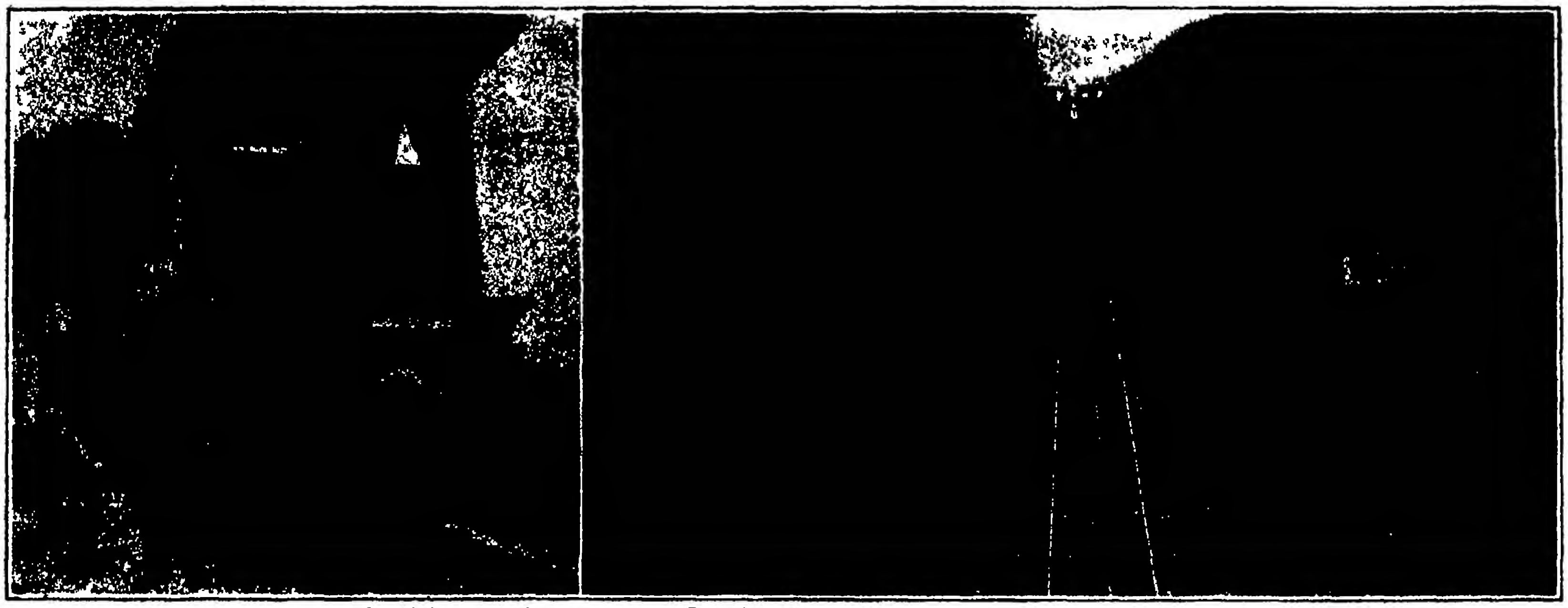
The cog wheels provide the cars with both service and emergency brakes, the service brake of either car being sufficient to stop both cars at any point in the course. Ordinary service braking is done by the guard of the down coming car who in this manner naturally regulates the speed of both cars.

Suspended at a 45 degree angle on a 3-foot lever at each end of the car on the left side are two 200-pound weights, one of which assists the guard in ordinary service braking, while the other remains at all times suspended on a small trigger slide, and is so designed that in case the cable breaks, both weights drop on both cars, stopping them instantly. The cable attachments are at the forward end of the cars at the lower end of a malleable iron rail swung on a swivel, with the upper end against a strong tension spring, which is compressed while the cars are in motion, but in case of the cable parting would throw back the rail releasing a lever connection which drops both of the weights. There is also an emergency brake-lever which can be used by the guard in case of necessity to drop these weights and set the emergency brakes.

The water that is used for the filling of the gravity tanks on the cars is supplied from a large concrete basin about 30 feet in diameter by 8 feet deep which is located at a point higher up than the Summit Station, and is fenced in to avoid any refuse being thrown in. A pipe line to the Summit Station is large enough to fill the tank on the car in a few moments.

The water that is released from the car at the City Station flows into a 30-cubic meter-capacity cistern located underneath the platform. When this tank is nearly full, the water is pumped back through a pipe line to the basin at the top of the summit by a small centrifugal pump that is directly connected to an 11 kilowatt electric motor supplied by a 500-volt line and running 2000 revolutions per minute. This pump will empty the cistern in better than one hour's time.

By using only a sufficient amount of water to pull the up-coming car very little power is consumed. On week days when traffic is light two to three hours per day are all that the motor and pump are used. However on Sundays and holidays when the traffic and schedule are increased to meet the demand, six to eight hours per day are required to keep the cistern emptied. As the water is used over and over again, very little water is required from the city supply, the only loss being what little is used to cool the braking system and through evaporation. The guards on both of the cars run the small motor and pumps and watch it while their car stands at the City Station, and thus the operating expense is reduced to a minimum.



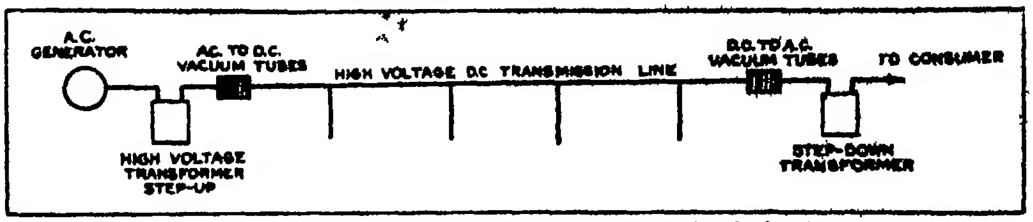
Left: One of the cars at the summit station. *Right:* The two cars at the passing switch which they take automatically

The gravity railroad up the Khranenberg, a mountain in the German Rhine country

Will the Direct Current Era Return?

Discussing the General Question of Oscillating and Rectifying Vacuum Tubes as Applied to Power Distribution

By Raymond Francis Yates



Schematic arrangement of the units used in generating and transmitting high-voltage alternating current, and then stepping it down and rectifying it into direct current at low voltage

BEFORE the days of Tesla's induction motor and his wonderful work on the application of alternating current, direct current reigned supreme. Pure necessity ushered in the alternating-current era and brought about a revolution in the electrical industry. Those of us who have watched the development of electron tubes have come to realize that there is at least a possibility that the present limited application of direct current will be greatly multiplied within the next few years. The suggestion is at least alluring and the many engineering developments that have taken place in vacuum tube work point out clearly the amazing possibilities that lie in this direction. Of course the writer does not mean to infer that direct current will crowd alternating current out of the field entirely, that would be nothing but the rankest kind of idle speculation. The fact to be brought out is this. Certain engineering difficulties now prevent direct current from being used where it is most needed. The application of the vacuum tube will overcome the obstacles that now interfere.

For certain work the direct-current motor is ideal in every respect. In steel mills the direct-current motor is most efficient for use on the rollers where continual changes in speed are necessary. Of course, alternating current motors may be used, and they are used, but their use is attended by a considerable wastage of power or by the complication of several added machines for each motor. The induction motor is most efficient at certain speeds and any decrease in speed beyond very definite limits brings about a great waste of power.

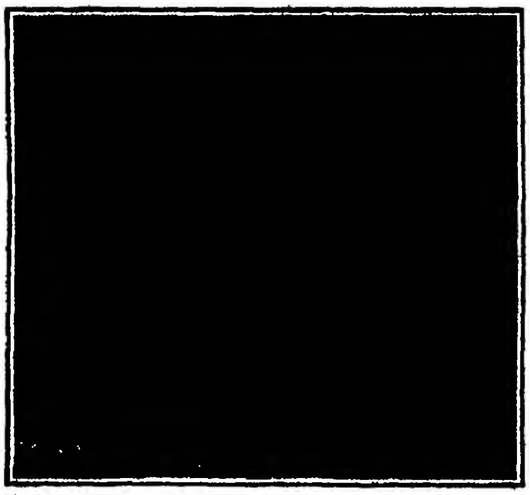
Although alternating-current systems are used to some extent in transportation work, the direct-current motor is the most suitable for this purpose. The Norfolk & Western, for instance, use single-phase alternating current with a phase changer in the locomotive which provides three-phase current for the driving motors. On the other hand, the Chicago, Milwaukee & St. Paul employs 3000-volt direct current for locomotive operation. The direct-current installation is by far the most efficient where widely varying speed is required. From the standpoint of engineering and from the standpoint of economy, the use of direct current in all transportation work is highly desirable.

Series street arc lighting systems operate most efficiently with direct current, and, of course, direct current is an absolute necessity in electrochemical work.

The layman will ask "If direct current is best for these purposes, why not generate and use it?" Unfortunately direct current cannot be transmitted over great distances at low voltages without a great waste. Low-voltage current of any kind cannot be transmitted any considerable distance without appalling losses. The voltage of alternating current can be raised to practically any value through the use of transformers, and since voltage or pressure is necessary to overcome the resistance offered by the long transmission lines, alternating current is quite naturally used. In fact, alternating-current transmission lines are now in use with voltages in the neighborhood of 200,000. Direct current, owing to its nature, cannot be transformed, and certain engineering difficulties also present themselves in the generation of high voltage direct current. To the writer's knowledge, the 3000-volt line on the Chicago, Milwaukee & St. Paul system is the highest voltage direct-current system used in this country.

Although all of our electric power is transmitted over long distances through the use of alternating current, this form of transmission is by no means ideal in every respect. The use of direct current would be much better providing its voltage could be raised to the proper value. The inductive effect of high-voltage alternating-current lines is extremely troublesome in many cases. It not only causes power losses, but also brings about trouble in adjacent power, telephone and telegraph lines. Further losses are brought about by the "skin effect," which has a retarding effect on the passage of the current that must be added to the ohmic resistance of the cable used. The capacity effects of high-voltage alternating-current transmission lines also causes fluctuations in the voltage.

Although none of the losses or disadvantages mentioned above occur in direct-current transmission, the limiting transmission pressure is fixed by the maximum pressure which can be employed on the various translating devices, such as lamps and motors.



It is held that the simple vacuum tube must some day replace elaborate rotary converters such as this

During the past few years a great deal of work has been done on vacuum tube devices, and it is the development along this line that makes the further application of direct current look so promising. The Kenotron tube, produced by the General Electric Research Laboratory, is a wonderful rectifying device. By this is meant that it is capable of rectifying or changing an alternating current to a continuous or direct current. Tubes may be oscillators as well as rectifiers—one is the converse of the other. (Oscillator tubes are used in radio work and require the Armstrong regenerative arrangement.) When work started along this fruitful line of investigation, tubes were made that would handle only a few milliamperes of current. Today tubes are made that are capable of handling several amperes, and before long it is said that they will be made to handle currents measured in kiloamperes. The efficiency of vacuum tubes is low when they are operated on low-voltage currents, but this efficiency rapidly increases as the voltage raises, and engineers today see no reason why tubes cannot operate with an efficiency as high as 99 per cent.

Will it ever be possible to install a battery of vacuum tube rectifiers on a locomotive and operate the motors with direct current from a high-voltage alternating-current line, or from a high-voltage direct-current line? This is a question that is interesting engineers at the present time, and there is a great deal of discussion regarding the matter. If such were the case, an electric locomotive could have all of the advantages offered by direct-current locomotion from an alternating-current line. The alternating-current line is not so desirable, since it causes telephone interference and must be single-phase, which is not as economical as three-phase.

The power sub-station offers another possible field for the application of the vacuum tube rectifier. Here it would replace the costly synchronous converters. A small battery of heavy current tubes placed on a rack would take the place of a machine that costs many times as much as the tubes. Moreover, the tubes would not need the constant attention that is required by the synchronous converter.

The use of vacuum tubes in the electrochemical industry is also possible. However, special conditions exist in this field, and the tubes that are being developed today could not be applied to this work, since they are essentially high-voltage devices and the electrochemical service calls for a low-voltage tube. Present-day tubes can be operated on comparatively low voltages, but the efficiency falls off rapidly. It is more than remotely possible, however, that a suitable low-voltage tube will be developed for this work. It may or may not be a vacuum tube. Perhaps it will be a vapor tube of some sort.

High-voltage direct-current transmission is the most interesting phase of the question to be considered. The use of a highly efficient tube for such work would bring about a large saving in line losses. At this point it might be well to quote Mr. Albert W. Hull of the General Electric Research Laboratory. "Twenty years will see direct-current transmission lines, fed through transformers and Kenotrons, at any convenient points by alternators of any frequency, and tapped by the same tubes, acting as magnetron alternators, or some equivalent Pliotron or combination vacuum tube alternator." In the future, then, will our substations contain only a few transformers and a rack full of vacuum tubes?

A 4 by 12 inch magnetron. The vacuum tube is capable of rectifying alternating current into direct current, and, conversely, can oscillate so as to produce alternating current from direct current

Specifications for China and Glass Tableware

FOR some time tests have been conducted by the Bureau of Standards of the chinaware commonly employed by hotels and restaurants with the idea of eliminating breakage and unnecessary sizes.

A meeting was held recently at which the U. S. Potters' Association was represented and considerable satisfaction was expressed by the makers of chinaware at the bureau's work. Offers of considerable additional ware for experimental use were received, and it is probable that the investigation will be extended to cover all varieties of this material.

All government departments have now accepted the tumbler specifications prepared by the bureau, and it is probable that these will be printed so as to make them more generally available. As considerable interest has been shown in the work, an article is being prepared which will be submitted for publication in several of the technical journals in the immediate future.

The Tomb of an Egyptian Queen

The Metropolitan Museum Scores Another Triumph in Finding the Sarcophagus of Aashait

By Albert A. Hopkins

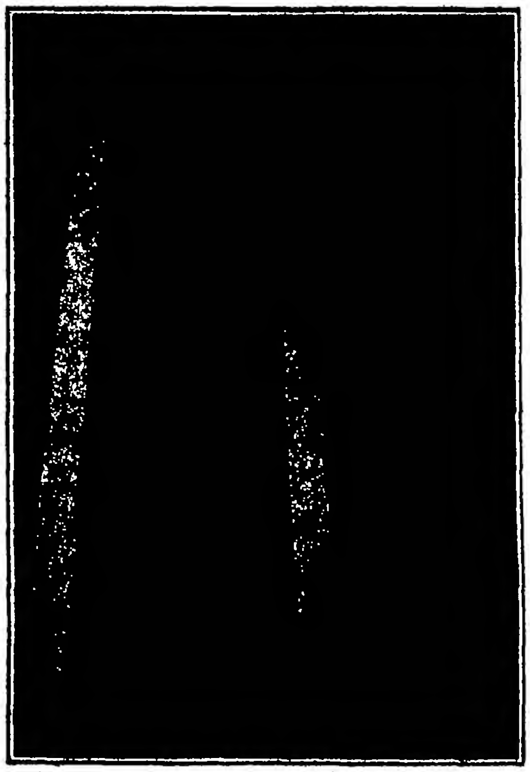
A FEW months ago we described the beautiful and interesting miniature models showing Egyptian life, trades and customs which were taken from the tomb of Mehenkwetre and which produced the archaeological sensation of the decade when they were put on exhibition. Now we can chronicle a find fully as interesting, but the tangible results will have to be deferred, for the plan of operation in Egypt is on what we usually call a "fifty-fifty" basis—that is, half the objects found remain in Cairo and the rest come to this country. This year the exhibits secured by exploration were so fine and important that they could not be so readily divided as could the models, where a miniature slaughter-house could be offset by a miniature bakery or brewery. The division is made in all fairness, but it goes by value, not quantity, therefore it was thought wise to withhold the material and divide it in a lump with the finds of next season.

It was very natural for the explorers to hark back to the same neighborhood which gave the valuable discoveries of the mummy of Prince Amenemhet in the Spring of 1919 and the models of Mehenkwetre in 1920, so the excavations in Thebes were resumed. The little valley in which they worked for two seasons is a weirdly romantic place, even for Thebes. There is little trouble from tourists, who seek the more spectacular ruins, and almost the only figure seen in the desolation is an occasional fox. Even in the days of remote antiquity this city of the dead was deserted, so that it is little wonder that thieves occasionally broke in. Our engraving gives an idea of the wild beauty of the desert area. The last picture shows the platform where over two hundred men and boys dug away the masses of rock and sand that had fallen from the cliffs and the little iron cars that carried off the débris. Leaving for the moment the more abstruse details of the eternal grind incident to archaeological exploration, we pass to one of the actual finds.

Once upon a time there lived in Thebes, about 2000 B. C., a young queen who would look all right today with her bobbed hair and her pet dog sitting under her chair, but she passed away at the early age of twenty-two and was buried with all the pomp and circumstance of her exalted rank. She did not rest in peace, however, for sometime in the interval of 3921 years that elapsed thieves broke in and rifled the tomb. The violation of the tomb occurred about 1600 B C. Mr H. E. Winlock, the head of the expedition, describes the find as follows

"The artists who fashioned the magnificent sarcophagus of Kauit now in Cairo—a piece of sculpture which has been taken as one of the classical examples of Middle Kingdom art ever since its discovery—made Aashait's sarcophagus as well. It is a masterpiece of the sculpture of a school which was still archaic, but of a technical skill rarely equaled.

"On the east side is a representation of the palace doorway with the balcony above, from which Aashait was supposed to look out upon the world through two graven eyes. Within the palace all manner of good things are heaped before her, while she sits with her dog under her chair and a maid behind her, fanning her with a duck's wing. She drinks milk which the dairymen give her fresh from a pair of cows that are



Aashait's coffin, as the inevitable thieves left it

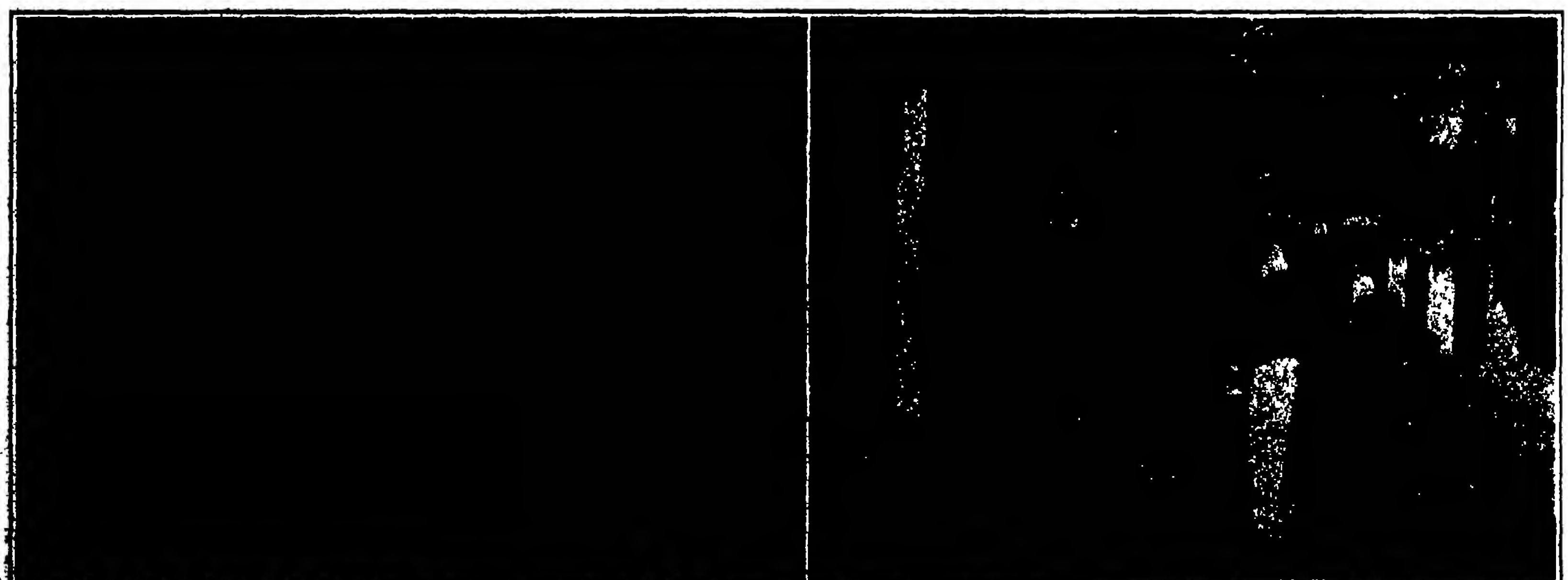
brought in with their calves, or she visits her farm where her steward superintends the peasants carrying sacks of grain up into her granaries. Her maid gives her jars of sweet-smelling perfumes from the boxes in her closets, and her butchers slaughter an ox and heap a dinner-table mountain high before her. Inside, the same scenes are repeated in brilliant colors, for such were the events of her daily life and such were her hopes of the world to come.

"On the wooden coffin which stood inside the sarcophagus, the subjects of the decorations belong more to the mysterious realm of magic Outside it is severely plain, with fine-grained wood relieved only by bands of gold along the edges, by deeply carven prayers and once again the eyes which look out upon the world Inside, all is of a weird brilliancy The lid of the coffin is the sky and on it is painted an astrological almanac in tabular form, giving the rising of the stars and constellations through the twelve hours of the night, and a long prayer to the beings of the firmament Our "Great Bear" we find masquerading as a leg of beef Long magical texts cover the sides and ends of the coffin and above them are ranged in rows item after item taken from the catalogue of the amulets and talismans necessary to the soul that would escape the dangers and the pitfalls of the netherworld The student of religion and magic will find here a wealth of data on man's ingenuity in inventing the jargon of mystery

"Inside the coffin Aashait's body had been laid in a mummiform cartonnage, which in spite of its wrecked condition is an important document on Egyptian mortuary customs. Over her had been piled masses of bed sheets to cover her in her eternal sleep and in the corners of them the explorers found the linen marks of the royal palace of four thousand years ago—sometimes simply King Mentuhotep' or 'The store of fine linen or again the name of the steward who superintended its making or its acquisition By her side had lain her statuette, archaically stiff with gold bracelets and a red skirt held up by white suspenders.

"The thieves who broke into Aashait's tomb had been looking primarily for precious metals and little had escaped them A few beads from her necklaces, a shell bracelet of no value to them, and two silver bead anklets were all that they overlooked, but by good fortune during the four centuries she lay in peace her jewels had left casts in her bandages, which time had not obliterated, and from them we were able to draw a diagram of all she had worn To make room for their work, they had swept aside most of the offering pots and the joints of beef supplied for Aashait's ghostly life, and they had broken the lid of the sarcophagus to get at her body Beyond this, however, the sarcophagus, the coffin, and the statuette had suffered no material damage and all three have come down to us almost as fresh and clean as the day they were made

Other coffins were also found to have been rifled One of the finds in a big sarcophagus was a little white-washed wooden coffin of a child named Mait Inside the explorers found a second coffin in which lay a pile of linen bed clothes covering the little mummy There lay Mait with the eyes of her plaster mask gazing through the eyes painted on her coffins While the cof fins were small, the wrapped mummy with its mask



Left: Hauling the sarcophagus from its resting place. Right: Carrying Mait's coffin through the ruins of the temple

Metropolitan Museum workers engaged in a discovery of more than usual value at Thebes

was much smaller, and when the explorers came to unwrap it they found that, small as it was, it was most ly padding at head and foot to disguise the tiny proportions of the little infant within, which the archæologists called pathetic. The finery which she wore in her short life was all there five necklaces in all. One was a string of hollow balls of gold one was of carnelian, two necklaces of minute beads of silver carnelian, green feldspar and rich blue glass and finally a necklace of gold disks so fine that strung on leather bands they look like a supple tube of unbroken gold. The carnelian necklace was even preserved on its own string Little Mait must have been a blaze of color four thousand years ago

Alaska Once Subtropical

THE ancient vegetation of the Arctic region, as is shown by a study of its fossil plants, indicates that its climate was once very unlike that which prevails there now Instead of consisting of a handful of small plants struggling for life amid snow and ice in a scant, almost perpetually frozen soil, its vegetation was abundant and luxuriant and included ferns and palm-like plants that grow only in a mild and probably frostless climate This vegetation flourished in the Arctic region from at least late Paleozoic to middle Cenozoic geologic time, millions of years ago, before man existed. Although these lands are now so inhospitable and are rarely visited, the United States Geological Survey has gathered a large amount of information concerning their fossil flora.

A study of the coal beds of the Cape Lisburne region has incidentally disclosed many fossil plants. These coal beds are extensive and are the only known commercially valuable mineral resources of that region. A little coal is occasionally mined for vessels that are short of fuel, which as there is no harbor, lie offshore and perilously load on a few sacks of coal by means of lighters.

Cape Lisburne is the headland which marks the northwest end of a land mass that projects into the Arctic Ocean from the western coast of Alaska about 160 miles north of the Arctic Circle and about 300 miles directly north of Nome Even Cape Lisburne is by no means the northern limit of the fossil plants of this nearly tropical vegetation, for they have been found in the rocks 180 miles northeast of that Cape

Archæology on a business basis: the light railway that is used in modern exploration of ancient building sites

Burning Up the Corn

An Emergency Measure of the American Farmer, and What It Means

By H. C Hardy

THE Indian, who gave corn to the world has a superstitious reverence for his principal food staple and occasionally burned it as an offering to his tribal gods But it has remained for the white man and his economic difficulties to make of corn a fuel

Much has been made of the "crime" of burning food. The good people who argue that because human beings in Russia or the Far East are hungry therefore to burn corn for fuel in this country is a crime, have their hearts located where their heads ought to be It is no more a 'crime' to burn corn for fuel than it is to burn coal to make electric light instead of burning it to heat the house of people who happen to be cold

Corn, like any other commodity is valuable only in reference to its location A farmer who possesses corn which is valued at \$100 as food but which can give heat equal to \$150 worth of coal is criminal not if he burns it, but if he sells it For to make up the difference he would have to dispose of other food products, which, if he burns his corn, may either sustain him or be sent to starving Russians.

With the "crime" idea eliminated let it be chronicled that the amount of corn burned in the United States has been grossly exaggerated by the newspapers, especially those which cater to people who carry their hearts on their necks and keep their heads in storage Secretary of Agriculture Wallace made out the case for corn as fuel as follows

Ear corn at 20 cents a bushel is equal in fuel value to a fair grade of western soft coal at approximately \$10 a ton In districts where corn is very cheap now the coal is usually of a rather poor grade and is selling at high prices Under such conditions it will pay both farmers and people in country towns to use corn instead of coal

"Because of the variation in quality of both corn and coal it is difficult to make scientific experiments the results of which are applicable everywhere, but, speaking generally the relative heating values of corn and coal are about as follows

"Corn at 10 cents a bushel equals coal at \$5 per ton. Corn at 16 cents a bushel equals coal at \$8 per ton At 22 cents a bushel it equals coal at \$11 per ton and at 30 cents a bushel it equals coal at \$15 per ton."

To be successfully burned, of course, corn must be dry—the drier the corn, the greater the heating value. Some farmers have burned shelled corn, but dried corn handles more easily and makes a better fire burned on the ear.

Burning corn is not new It was done in the early history of the West when corn was cheap and coal dear and in Argentina corn is burned not only on farms but in power plants. In any situation where the price of coal is largely increased by the haul from railroad to market, corn, at low market prices, becomes a fuel competitor The farmer who burns his corn avoids the haul of corn to market and the rehaul of coal to home

But on the other side of the problem stands the great American hog, who grunts disapproval of the use of corn as fuel With corn selling around 25 or 30 cents a bushel it is better economy for the farmer to feed as much of his crop as possible to hogs, despite low prices of pork Results of numerous experiments in feeding hogs on corn rations alone show that on an average about 10 bushels of corn can be expected to produce 100 pounds of pork In experiments where other feeds, notably grazing crops, have been used to supplement corn results have been better

With corn selling at 35 cents per bushel, pork can be produced, on this feed alone, at an average cost of \$3.63 per hundred At 40 cents per bushel, it should cost \$4 15 to produce a hundred pounds of pork If live hogs sell at 7 to 8 cents per pound, the farmer who feeds 35-cent corn and produces a hundred pounds of pork for \$3.63 still has a pretty safe margin of profit Another factor in this connection worthy of the farmer's consideration is that in feeding corn to hogs, approximately 80 per cent of its fertilizing value is retained on the farm instead of being sold.

The Department of Agriculture shows the importance of corn in the agriculture of the United States by figures for the decade 1908 to 1917. In that period the acreage devoted to corn in this country was 4 8 per cent greater than the combination acreage of the crops of wheat, oats, barley, rye, rice, buckwheat and flax. The value of the corn crop for the same period was 24.3 per cent more than the combined values of these crops. During the same decade the number of acres in corn was 18.7 per cent in excess of that for the previous decade. A growing increase in the price per bushel for corn is indicated by the fact that the value of the crop was about 100 per cent greater in the past decade than in the previous one.

Roughly, we plant a hundred million acres in corn and reap three billion bushels. Should the SCIENTIFIC AMERICAN make out of these figures one of its illuminating comparisons in which statistics are made to appear as pictures, it would have its artist draw a globe, and a wagon train crawling around it in nine and a half spirals, each wagon containing 50 bushels and each wagon occupying 20 feet of space

It is obvious that no such food crop could be largely diverted to fuel purposes from the world's larder without so revolutionary an upheaval of the world's bill of fare as would make the highest of high war-food prices seem pre-warish by comparison The fact that corn is still low priced, and pork also, is sufficient evidence that no very great amount of corn is being fed to stoves and boilers The best evidence of exaggeration is the fact that Uncle Sam's big farm agency, the Department of Agriculture, has no statistics on the amount of corn burned as fuel, and does not believe that the practice has been largely followed, in spite of the excellent advice as to its economy given by the Secretary

Corn, of course, is primarily food It may be of interest to recall that in this country it has also been used as money, Indian ornament, source of sugar, tax medium, ammunition among the early settlers when lead was lacking—and now as fuel If the sentimentalist will undertake to lay down, at the farmer's door, some other fuel at a price that competes with the value to the farmer of his corn, you may be sure that what burning of corn there has been will cease. If corn burning is something to be remedied, the remedy lies not in shedding tears about the starving Russians, but in raising the price of corn or lowering that of coal or wood or oil or something else that will make a fire When other combustibles cost more at the farm than the farmer can get for his corn, it stands to reason that he will burn the corn—and he is right in burning it.

Even when we think in terms of the community at large rather than in terms of the individual, it ought to be pretty obvious that what makes fuel high to the farmer is the necessity of getting it to him; and that what makes corn low at the farm is the fact that it still has its transportation to buy and pay for Transportation is today one of the most high-priced of all the commodities which go to make possible the civilized life, and one which we must, in the interest of all, economize at every turn. When the balance of prices is such as to lead the farmer to burn his corn, we may be very sure that one of the chief reasons for this condition is that we cannot, as a community, afford to give over our transportation facilities to the interchange of corn and coal between farmer and city. There may be some occasion for excitement in this condition, but the excitement should not be directed at the farmer, who, by burning his corn, is doing his share to meet the conditions and to make the visible supply of transportation go around.

Magnetism in Human Beings

By Dr. Alfred Gradenwitz

THAT some persons in every respect behave like living magnets, and that this behavior not only is closely connected with physiological and psychic phenomena, but opens up unthought-of vistas on the further investigation of body and soul, is the conclusion reached by Frits Grunewald. This investigator has carried out a remarkable series of experiments on a Mr P I—a gentleman personally known to the author, who, like Mrs. Ruf (examined, as far back as in 1867, by Fechner) is able with his hands to deflect the magnetic needle, his two hands generally showing opposite polarity.

That this action on the magnetic needle actually is to be ascribed to magnetical rather than electrical or any other effects, was shown conclusively, for on pushing his hand through a coil of copper wire, the person experimented on would induce there an electric current, indicated by the deflection of an ammeter connected with the coil, just in the same way as by pushing through the coil a magnet bar

It was, of course, interesting to ascertain whether the will of the person would exert any influence on these phenomena This was soon found actually to be the case. Mr P I, with his hand kept perfectly motionless, was able to alter the magnetic force and, accordingly, the current intensity, by as much as 10 per cent

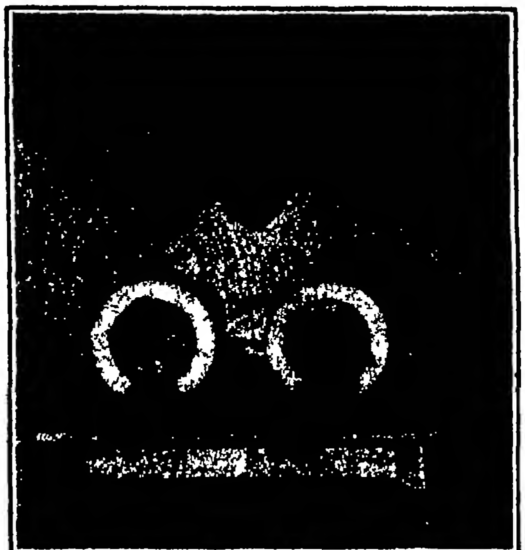
By examining the whole body of the person as to the presence of magnetism, Grunewald has been able so far to ascertain that the hands, arms and temporarily, his head will exhibit magnetic properties. By means of iron filings spread out on a glass plate he has in the usual manner produced pictures of the lines of magnetic force. In several cases the existence of two poles, marked as bright spots on the remaining filings and from which the lines of force would spring forth, could be stated on these magnetic pictures above the person's hand. With an experiment made on the person in a hypnotized condition Mr Grunewald could even count no less than 14 different magnetic centers.

Especially interesting are the relations between magnetism and physiological phenomena, as discovered by the experimenter The deflection of a magnetic needle arranged above the hand would undergo an alternation corresponding to the rhythm of breathing, increasing during inspiration and decreasing during expiration Not less striking was the fact that the magnetism, which in the morning, immediately after getting up, showed a negligible value, would in the course of the day undergo an increase after each meal

Though the existence of a vital energy as asserted by "magnetopathists" is as yet denied by most medical men, Grunewald would seem to have been the first to demonstrate in a palpable, objective way, by the use of his ballistic method, the existence of a vital energy transferable from one person to the other In the case of 115 "magnetic" treatments carried out by Mr P I. since 1917, he was able to ascertain a decrease of magnetic intensity attending, it would seem, the giving off of vital energy. In fact, after such a treatment, lasting, as a rule, for a quarter of an hour, this intensity would drop to one-third of its initial figure, and in cases where Mr Grunewald himself underwent the treatment, the most marked decrease would, strange to say, be noted whenever previous to the treatment, he had felt especially weak, that is, had been especially in need of a supply of vital energy

In order now to make sure whether the weakening of the action exerted by the magnetic needle is not simply due to the physical work yielded, Grunewald caused Mr. P. I to perform a check test, viz., some sort of "blind" treatment, in connection with which similar strokes were made through the air The result of this blind test was remarkable, the magnetic intensity (and accordingly the susceptibility to "magneto-therapeutical" treatment) so far from decreasing, having undergone a striking increase. In fact, Mr P. I., as it were, had absorbed something like vital energy, an hypothesis confirmed by the fact that, *without knowing anything of the results of these measurements*, that is, without being under any suggestive influence he would state that, on striking through the air he had experienced an increasing resistance, with a strange consciousness of absorbing something This result of objective tests involuntarily reminds one of the assertion made by Hindoos, that they for thousands of years have been in possession of the art of absorbing "Prana," *i.e.*, vital energy, from the atmosphere, by means of a special technique of breathing or gymnastics.

A striking line-of-force diagram of the magnetism observed in Mr. P. I's hand The same diagram is shown, alone and superposed upon the subject's hand



When the subject pushes his arm through a coil of wire, the magnetic force therein is sufficient to induce an appreciable current in the coil

A Mechanical Sun and Moon

MOST of us can, without actual reference to models or diagrams, get a very decent mental picture of any series of motions, so long as these motions confine themselves to a single plane When the bodies in question abandon the plane and travel through the three dimensions of space, however, the fact immediately emphasizes itself that we are fundamentally a two-dimensioned race

One case of moving bodies in space is that furnished by the earth and the two bodies that illuminate it—the sun and the moon To understand the phenomena of daylight and darkness and moonlight at all properly—to say nothing of the seasons, the variation in length of daylight, and the other subsidiary matters dependent upon the rotation and revolution of earth and moon—the ordinary citizen is utterly helpless in the absence of a working model of some sort

Such models are not to be bought in every hardware store—or even of every dealer in scientific apparatus Their accurate design and construction call for a degree of care and skill not everywhere available for to be of real value they must be working models and in no sense "stills" They must show the course of the earth about the sun and of the moon about the earth, they must show clearly the successive phases of this complicated system

The latest addition to the small family of models that do all this is illustrated herewith It is designed and built by Mr William Wilson of London As a fair example of the difficulties inherent in such a piece of mechanism we may remind our readers that if it were not for the inclination between the plane of the moon's orbit and that of the earth's path about the sun the moon would be eclipsed every full moon and the sun every new moon But in the presence of the moon's orbital inclination if its orbit were entirely fixed we should have no eclipses at all! What happens is that the moon's orbit taken as a whole rotates about the earth, so that the point where the lunar track pierces the earth's orbital plane is now here now there—and sometimes between us and the sun at the moment when the moon is at this point in her journey

Description of the working parts of the model is superfluous so far as it duplicates the showing of the photograph, and we believe would be out of place if it went any further It may be well, however, to state specifically that the model is driven by hand. The long bar which directs the "earth" in its course about the "sun" is rotated manually by means of the handle on its end, which also serves as a balance weight and all the other motions of the model are derived from this by the several pulleys, etc shown

This model, unlike most of its predecessors, is not a mere curiosity, Mr Wilson is actually manufacturing and selling them to schools libraries museums etc It gives a complete picture of the relation between year month and day, the alternation of day and night the succession of the seasons, the phases of the moon, the various forms of eclipse—lunar and solar, complete, partial and annular, and the Saros or cycle of 18 years 11 days in which the succession of eclipses recurs In the abbreviated "years" and "days" of the model this cycle is just one day short—an error of one in 6600 Since the globe representing the earth carries a properly oriented map it is even possible to follow the track of the eclipses, and note where they are observable

A working model of earth, sun and moon, which reproduces the entire relative motion of these three bodies

Specifications for Window and Plate Glass

THE Bureau of Standards has recently tested a large amount of figured and wire plate glass, the results of the work showing great uniformity of the product In general the strength increases as the square of the thickness, as is the case with many other materials. Sufficient glass of each type is being tested to give an accurate and unquestionable average of strength for this class of material Sufficient information has been gathered to warrant the calling of a conference of those interested during the month of January

Curbing the Colorado

Flood Control, Irrigation, and Power Generation All In One Gigantic Construction

By Robert G. Skerrett

ALREADY, the electrical engineer has shown how the snows of the high Sierras can be transformed into energizing current distributable for hundreds of miles through a State which is notably deficient in deposits of power producing coal. Similarly, this same technicist is busy planning ways by which the widely diversified flow of the second largest of our rivers, the Colorado, may be stabilized and utilized to operate a number of immense hydroelectric stations.

The Colorado River drains a watershed covering fully 250,000 square miles, and in the course of a twelve-month its run-off amounts to 16,000,000 acre-feet of water. The States affected by the movement of the Colorado are Nevada, Utah, Wyoming, Colorado, New Mexico, and California. Normally, the Colorado runs to extremes. In dry seasons it is low and its speed of travel comparatively sluggish, but when the melting snows and rains of the wet months pour their fullness into the far-flung basin the river becomes a raging, torrential stream capable of doing an enormous amount of damage. Uncontrolled, this great waterway is a continual menace to the lives and the property of dwellers in the Imperial Valley and in the adjacent lands, lying below the level of the sea and situated both in the United States and in Mexico.

Properly regulated, it is estimated that the Colorado can be harnessed so as to develop a total of 4,350,000 horsepower and, at the same time, be employed to make fruitful through irrigation something like 2,250,000 acres of otherwise arid soil. To this end the Federal Power Commission has granted a preliminary permit to the Southern California Edison Company to develop 2,500,000 horsepower of this block of potential energy. How, it will be asked, are nature's tremendous forces to be curbed to achieve these ends and a river of such might bridled so as to do man's bidding year in and year out? The answer is by engineering boldness of a sort that staggers the imagination at first blush. The scheme involves nothing less than the rearing of a towering dam directly across the path of the waterway down in the depths of a canyon scoured out by erosive action during a period of thousands of years.

In view of the number of States concerned in any possible development of the Colorado, it is apparent that flood control shall be the first aim, the next consideration is the distribution of the waters for irrigation, and the third desideratum is the generation of electric power. The problem has been to devise means that would accomplish these results in the most effectual manner, in the shortest time, and with a minimum of outlay. Two projects have been under advisement for some time—the Boulder Canyon scheme, of the U. S. Reclamation Service, and the Glen Canyon undertaking which is fathered by the Southern California Edison Company. The dam contemplated by either of the interests would, so it is said, solve the flood control and the irrigation phases of the problem, but only one of them would permit the fullest utilization of the power resources of the river.

As the profile diagram accompanying this article shows, Boulder Canyon is located close to the foot of the slope, and while a dam 600 feet high erected there would create a vast storage reservoir of sufficient amplitude to regulate the stream's flow the year through, still it is plain that power plants established below that dam would be the only stations that could profit by the head of water so formed. Indeed, the practicable head would be limited to that represented by the height of the dam itself, *i.e.*, 600 feet. On the other hand, a dam 500 feet high at Glen Canyon, well up toward the top of the slope, would insure a head for power purposes of over five times that—3100 feet. That is to say, a series of power stations could be built between the base of the Glen Canyon dam and the lowland, and each of them, successively, could use the descending waters to actuate groups of powerful turbo-generators. The plan of the Southern California Edison Company is, therefore, especially interesting because of its magnitude and what it promises in the way of the fullest development of the river's resources.

While the matter of power generation constitutes the third and last reason for bringing about the control of the Colorado River, this department of the problem is, nevertheless, one of the great economic importance inasmuch as it has to do intimately with the continued prosperity and productive growth of a section of the nation which projects its reflexes throughout the length and breadth of the whole country. It is doubtful if the people at large are alive to what has been taking place in parts of the Far West during the last few years. Industrially, the progress of our citizenry there has been both heartening and amazing, and this march forward has been due in the main to three agencies: a favorable climate, a soil ready to bear abundantly when irrigated; and a strikingly wide and varied use of electricity. The future of southern California, for example, is dependent upon hydroelectric developments on a gigantic scale if the region is to become the manufacturing and agricultural center for which nature's bounty has peculiarly fitted it. During the single year of 1920, the population of Los Angeles alone was augmented by 100,000, and this sudden increase of 17 per cent is in contrast to a cumulative expansion of but 6½ per cent annually during the preceding decade. In short, by reason of the diversity factor—the many services to which electric current is put, the annual demand growth is at the rate of 60,000 horsepower in that municipality and the territory contiguous to it. This block of energy is enough to take care of the needs of 800 factories, the irrigating of 100,000 acres of land, and to supply energy for numerous purposes to 32,269 residences. To effect this power development and to install the necessary distributive network of wires involves an expenditure of $15,000,000, and the total outlay, when house and factory wiring and the purchase of motors and electrical appliances are included, is approximately $45,000,000.

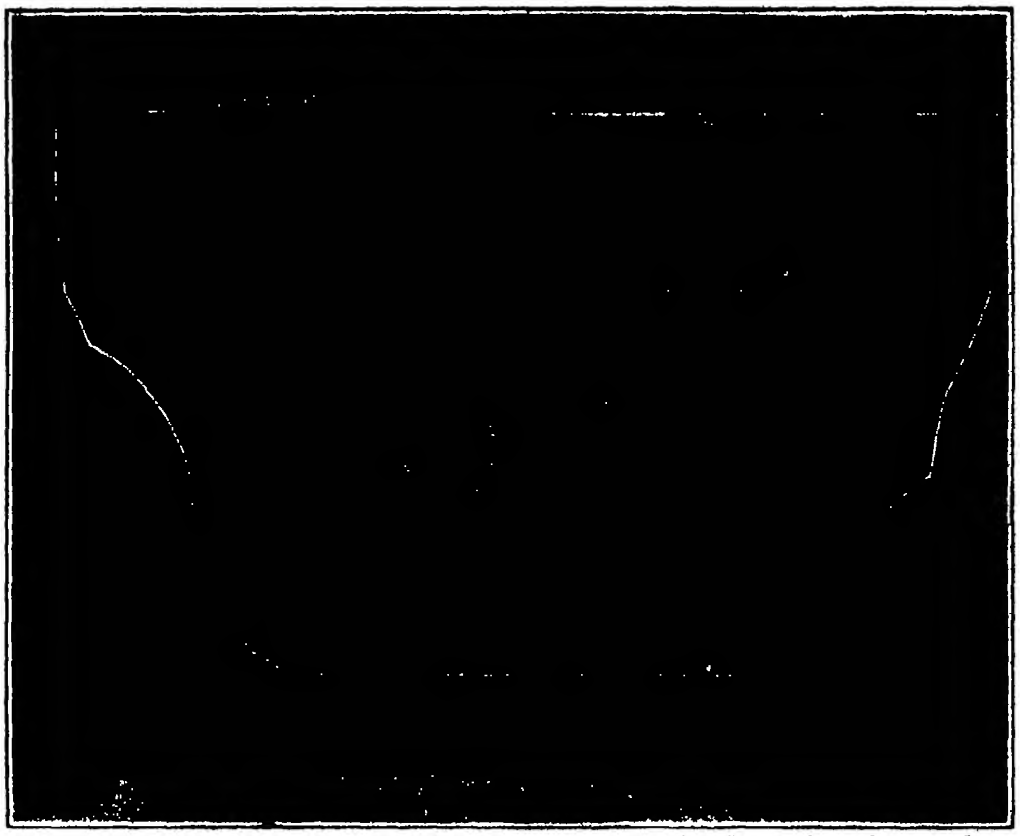
In these circumstances, it is evident that a steadily increasing amount of motive energy is indispensable to the well-being of that part of the United States which is doing so much towards transforming the commercial character of the Pacific coast. Therefore, the Glen Canyon project commands more earnest attention by all of us owing to the advantages which will ultimately accrue to the country at large through the consummation of this splendid engineering enterprise. In the end, the erection of the dam in Glen Canyon will do much to prevent a repetition of a shortage of power in California, such as was experienced in 1919, owing to the drought which then prevailed.

Glen Canyon is situated partly in Arizona but mostly in southeastern Utah, and the gorge at the point chosen for the dam site is 1800 feet deep. The walls narrow there so that a barrier only a few hundred feet from side to side will suffice to block the path of the waterway. With a height of 500 feet, as planned by the engineers, the dam will serve to create a reservoir northward for a distance greater than 200 miles, and thus accomplish the impounding of more than 40,000,000 acre-feet of water—*i.e.*, two and a half times the annual run-off of the river's watershed. As a matter of fact, the canyon is so constituted that it naturally would catch, when dammed, quite 96 per cent of the run-off, and by reason of its impounding capacity there could be held in reserve enough surplus water to neutralize a drought covering an interval of a whole year.

For the sake of those interested in comparative figures, let us see how this proposed lake of man's making looms up alongside other notable works of the hydraulic engineer. But first let us convert an acre-foot of water into the common term of gallons. An acre-foot is water overlying an acre to the depth of one foot, and this is equivalent to 325,829 gallons. The capacious Ashokan Reservoir of New York City's Catskill water supply system is capable of holding 132,000,000,000 gallons, or 405,120 acre-feet—just about one-hundredth part of the water that could be carried within the titanic basin of the Glen Canyon Reservoir. The next nearest approach in capacity are the artificially created storage facilities on the Nile, where barrages hold for deliberate distribution a total of approximately 3,500,000 acre-feet of water—not one-tenth of the amount that will be taken care of within the Glen Canyon reservoir!

We are assured that the rearing of the 500-foot dam at Lees Ferry will make it feasible to control absolutely the quantity of water discharged southward into the river's course, and that this volume at no time will exceed that which can be accommodated without fear of violence within the Colorado's natural banks. Therefore, the need of levees will be substantially eliminated. These defensive media have been costly expedients heretofore in the efforts made to keep the river within bounds and to prevent the inundation of large areas under cultivation.

As it exists today, the Colorado is virtually of no value for transportational purposes, and, at times, for long stretches, is impassable. The Glen Canyon storage basin, on the other hand, will make 200 miles and more



Looking downstream on the Colorado River at the site of the Glen Canyon dam, showing where the dam will stand and how it bulks against the Washington Monument

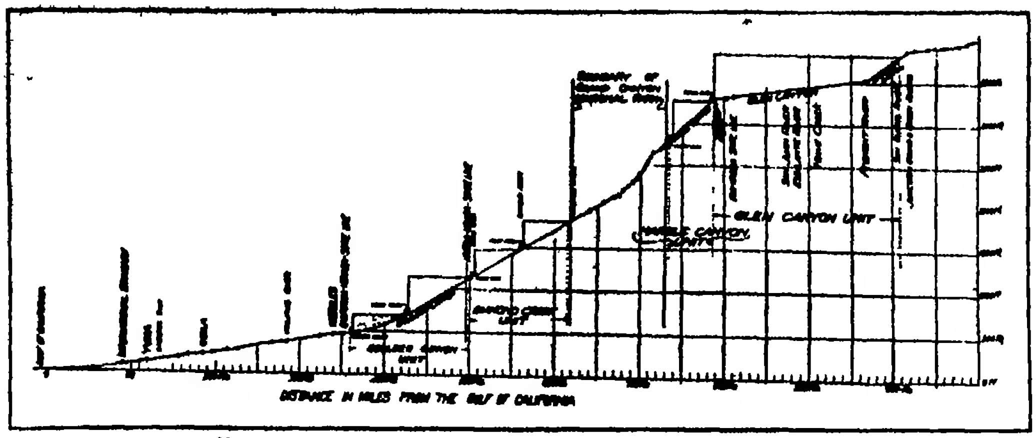
of the river navigable. This will inevitably prove of prime value in promoting traffic and in stimulating industry where physical conditions now hamper intercourse. But let us get a more intimate idea of what the scheme offers in the way of greatly amplifying blocks of power

Today, the flow of the Colorado ranges from a minimum of 3500 cubic feet per second to a maximum of about 200,000 cubic feet per second, and when the latter state prevails the stream's flow is substantially identical with that of the Niagara River. The drop of the Niagara River between its upper section and Lake Ontario is 300 feet in round figures, and of this head only 200 feet is utilized by the existing hydroelectric plants. On the other hand, there is a fall of 2600 feet on the Colorado River between the Glen Canyon dam site and Boulder Canyon, and, with the 500-foot head of the impounded water within Glen Canyon there would be available for power purposes a total drop of 3100 feet —more than 15 times the head today engaged in working wonders among the industries energized by the Niagara River. As matters stand, by international agreement, hydroelectric stations on the American side of the Niagara are allowed to divert for power only 20,000 cubic feet per second.

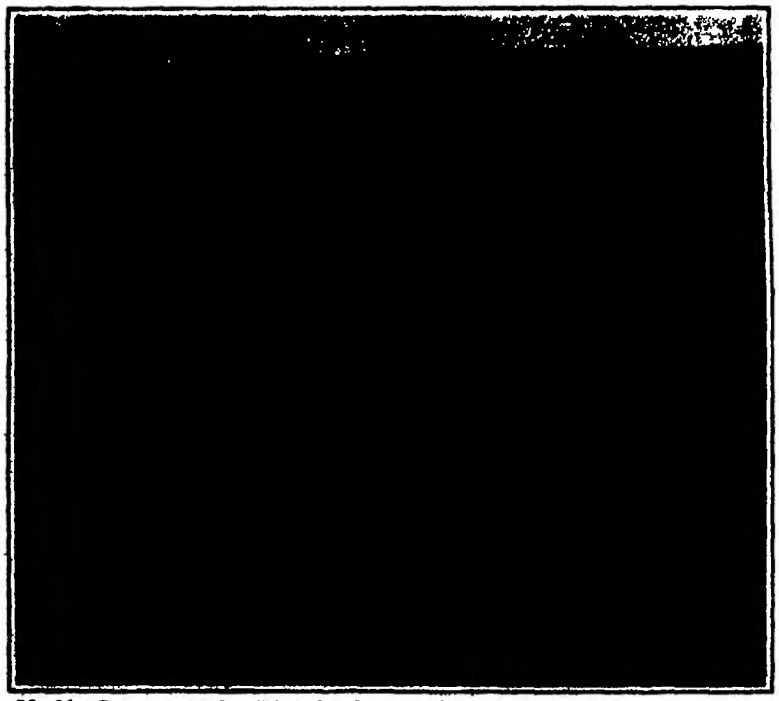
The plan for the control of the Colorado River contemplates regulating its variable flow to a uniform one of about 18,000 cubic feet per second. This volume of water, in combination with the heads that will be available, at different points, will make it practicable to generate a far greater measure of electrical energy than is feasible at or contiguous to Niagara Falls. The motive force so developed can be distributed north and south, east and west, within a radius of several hundred miles —a potential of 220,000 volts to be employed to effect this. The current so available may be used to electrify existing steam railways, which would call for about 35 per cent of the total, and the remainder would be placed at the disposal of the farmer, the miner, the manufacturer, and the divers demands of towns and cities. It is computed that the hydro-produced energy would result in a reduction in fuel oil consumption of something like 90,000,000 barrels every twelve months. This is an item of national moment, now that liquid fuel has become more essential to the driving of our battle craft and the ships of our merchant marine.

The areas that will be benefited by the Colorado River project and draw electricity from the stations there will embrace three-fourths of California, all of Arizona, Nevada, and Utah, more than half of Colorado and New Mexico, and one-fifth of Idaho and Wyoming. It is even possible that far-flung sections of Mexico will obtain current from the same source. It is suggestive that the territory to be eventually served by the Colorado River stations, within a radius of 500 miles, has today a population of 6,500,000. A similar zone, centering on Cincinnati, has a population of 65,000,000 people.

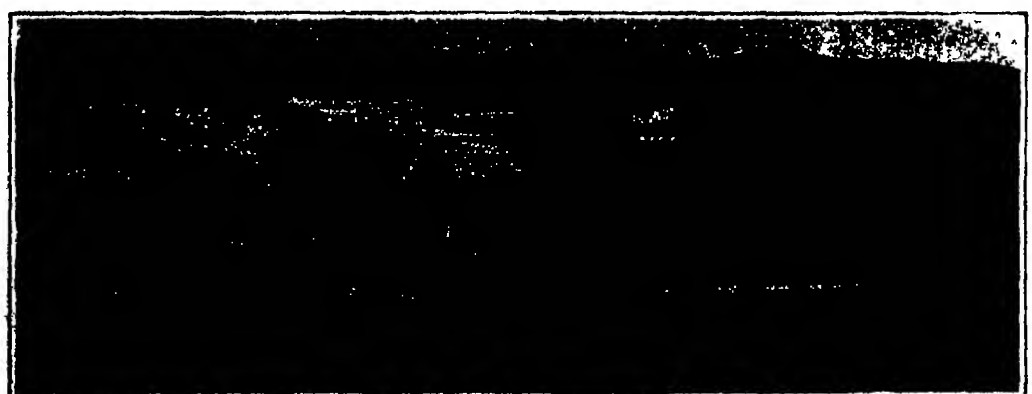
The dam in Glen Canyon will be situated 75 miles above Grand Canyon National Park, and, in passing, it should be remarked that no thought has been given to invading that reservation for power purposes, although it is recognized that the Park unquestionably holds great potential power resources. The ultimate development of the Colorado River includes the erection of power plants at Lees Ferry, Marble Canyon, Diamond Creek, Grand Wash, and Boulder Canyon, and the combined outlay would be approximately $1,250,000,000—*i.e.*, more than three times the money spent in the digging of the Panama Canal. Today, out of a total possible 4,000,000 hydroelectric horsepower within her boundaries, California has in service only 1,000,000 horsepower, and the remaining 3,000,000 horsepower must be made available promptly in order to take care of the normal annual demand growth in the course of the next fifteen years. If the railroads within the State are electrified, the yet unexploited 3,000,000 horsepower would be absorbed inside of a decade. The records show that the population of California has grown in the last ten years by about 45 per cent, but the electrical output, on the other hand, has been amplified more than 300 per cent. This is an index of the continually widening use of electricity and the unfailing call for more and more current.



Profile of the Colorado River, showing all contemplated developments



Marble Canyon, on the Colorado about twelve miles above the Glen Canyon dam-site. This gorge will form part of a storage basin 200 miles long



Laguna dam and canal headworks on the Colorado

The citizens of the Eastern States are familiar with California's fruits, which do so much to gratify the palate, and they are similarly acquainted with certain classes of green vegetables which reach their tables long before the home-grown produce is available. But California plays still another prime part in the agricultural side of our economic life: from her rich soil and flourishing fields the nation at large obtains a big percentage of the seeds needed by the truck and home gardener. But for irrigation, these would not be at our disposal, and we should be just so much the more dependent upon foreign sources of supply.

Whatever sectional bias the more intensely manufacturing districts of the East and the Middle West may feel towards the Pacific coast, it is inevitable that the whole nation recognize that those shores are lapped by an ocean within whose bordering lands dwell three-fourths of the population of the world. These peoples offer markets for tremendous quantities of manufactured commodities, and our States of the Far West are so located that they are nearest to these prospective customers. Clearly, the hydroelectric developments of the Pacific Coast States point the way to the creation of another dominating division of America's industrial empire.

Comfortable Houses Made of Straw

A CLEVER method of meeting the housing shortage has recently been devised by a French inventor named Feuillette. His building material consists of blocks of compressed straw which are molded into shape in a press similar to a fodder press. These blocks are used as fillers for a wooden framework: they are 40 cm wide and of any length desired to suit the distance between the timbers of the framework. The first row of blocks has sheets of tar paper between it and the foundation to prevent dampness. The outside is covered with a layer of water-tight reinforced cement of the same sort used in facing brick or stone walls, the inner walls are also covered with a light coating to which paper or paint can be applied. The windows are placed upon a special support of molded cement.

An important feature of the construction, according to *Le Génie Civil*, is a system of tubes inside the walls running around the perimeter of the foundation and around the first layer of the straw building block. Through these any suitable gaseous disinfectant can be passed so as to keep the house free from vermin. Since both the framework and the building blocks can be constructed in series and shipped to any point needed, these houses can be very rapidly erected: not more than a month or two being required to finish a residence and have it ready for habitation. Furthermore, the inventor claims that 40 per cent of the cost can be saved by construction of this character as compared with houses built in the ordinary manner.

One of the greatest virtues of these houses is the equable temperature maintained in them because of the poor conducting powers of the compressed straw. A number of them have already been erected in the Aisne and other parts of France. They are regarded as being specially adapted to agricultural regions where ordinary building materials are scarce. The elasticity of their materials, too, fits them to resist earthquake shocks. It is stated that the insurance companies insure them at ordinary rates in spite of the inflammable nature of their materials.

The Earliest Inhabitant

Some of the Simplest of the Animal Forms that Go Back Into Geological Time

By William Butterfield

NOTHING is more uncertain than the duration of geological time estimates of the earth's age, or of the length of certain periods therein, are tripled or divided by three overnight, as new data or a new method of attack upon the problem is developed. But whatever the number of millions of years which we attribute to the frame on which we live, for fully half this time, if not much more, it has been inhabited by the rhizopod family—the original member of which, indeed was its first distinctively animal inhabitant And so far as we are able to learn this individual *differed in form and action very little from his* descendants still existing, and known under various more or less pronounceable names. It is true that the founder of the dynasty has left no record or other evidence which will enable us to form a definite notion of his personality, character, or physical appearance, yet we may arrive at a fairly accurate understanding of this individual by a study of his lineal descendants

It is not at all difficult to meet a member of one certain branch we find hundreds of him inhabiting every square inch of decaying vegetable infusion, not quite putrid, lying upon oozy mud that has for some time lain covered by fresh or salt water This branch has a rather pretty name, ameba, and is said to be much more highly organized than the first inhabitant There is little to show that one group of the rhizopod family is more advanced than another, however all are extremely simple in everything that makes up their bodies.

It would be difficult to say exactly what *is* the form of an ameba's body It frequently has the appearance of a small, rounded mass, like a drop of water but whatever the form may be, it is always unstable, changing every minute It is among the simplest organisms in all creation—a mere particle of living matter Its body is like a drop of thin, almost transparent, mucilage, without head, trunk, limbs, envelope, mouth, stomach, or any appreciable organization whatever The amount of matter which forms it is so small (a mere twentieth of an inch in length) that often its transparency is such as to enable the eye to see it only by means of a careful arrangement of the light

Yet this semi-transparent drop of mucilage-like substance—*which we show in the drawing at 3 and 3a*—is endowed with life and a power of motion It projects from its body root like processes—which we show in the second drawing—at times simple sometimes branched These are the feet, upon which the animal moves, or the hands, with which at times it obtains its food Their appearance is different in the several genera Any projection, having appeared and remained for a short time, will be seen to reenter the common mass, with which it becomes completely reincorporated. When extended, if they come in contact they coalesce, running together like streams of water and often forming thin, lace-like structures.

The body mass is sticky, like the mucilage to which we have already compared it and filled with minute granules which are seen to be in constant motion, forming currents circulating within the body and its projections Smaller animals and vegetable organisms, coming in contact with any part of ameba, are attached to it and held by this viscid substance. The food particle thus sinks into the mass, if this be sufficiently large, and is *literally engulfed by it. If, however, it be caught* by too small a projection to effect this result, the animal flows more of its substance into the region in question and finally succeeds in absorbing the other particle. After digestion is completed ameba disposes of the effete matter by simply flowing away from it.

Reproduction of species is a process quite as simple as that of maintaining life All that is necessary is for the individual to separate into two or even more portions, each representing a somewhat smaller but none the less complete animal.

By investigating in this way the living forms of rhizopods we can arrive at a pretty fair understanding of the earth's first inhabitant. We may be sure that he could not have existed in a less primitive form, for the groups now living may be said to occupy the lowest possible place in the scale of creation, and he could hardly have been more highly organized, for his contemporary offspring have left us examples of their architectural productions which show this to have been out of the question.

To speak of architectural productions in connection with animals so simple in organization as we have found the rhizopods to be *seems startling to say the* least, but it is a fact nevertheless that the original users of architectural structure are to be found among this family Further than this, they were the first makers of artificial stone, which they used in constructing the prototypes of our modern apartment buildings. They were the original cliff-dwellers; and if we glance at their flats (Fig 1) we shall be surprised to see that they were by no means uncomfortably situated Each little dome-topped chamber, placed in rows, and connected by oval passageways, is quite as cozy as any thing that a human flat-dweller could possibly have Many of these "flats" were 50 stories high, each story connected to its neighbors by passages.

Flat-building was rather extensively practiced in the early days, and we find that the rhizopods must have constructed them in such numbers as to have covered practically the whole surface of the earth That was many million years ago, and a lot of changes have rolled over the earth since then, so we are now able to find only a matter of several hundred thousand square miles of their flat cities undestroyed—the Laurentian formations up in Canada, the oldest fossil formations known. We find that each individual animal builder was only the size of a pin-point, and that his apartment fitted his body in size. Each apartment was built upon the same plan, but they did not have the same number of rooms, showing that small and large accommodations were in demand then, just as they are now in man-made flats.

The flat-building cousins of the first inhabitant must have undergone a kind of industrial development in which this branch of the family, without change in their bodies, acquired the art of secreting liquid lime from the water in which they lived. From this accretion they constructed their artificial stone flats. This art became an industrial family possession, to which each member devoted a part of his time—each making his apartment in common vocation, just as the old guilds made cloth, leather, shoes or socks. This trait of animal behavior is called instinct We see it displayed again in the building of different and distinctive cocoons by the members of various tribes of moths and butterflies, in the tubes of caddis worms, and in the nests of birds.

The rhizopods were, we see the originators of industrial brotherhoods. If we look at any of the products of some living groups (Figs 2, 6, 8, 9, 10) we shall find that these families were the first great users of the art of masonry, and the inventors of mortar and stone cements. Some examples of rubble construction (Figs. 2, 9) are remarkably like such work as seen in stone fences, porch-posts and other up-to-the minute products of the human animal When it comes to the manufacture of fine colored terra cotta (Fig. 10) with an uncrackable glaze, we will find that the workers of these various groups have for hundreds of thousands of years been each surpassing each other in the mechanical precision and beauty of their work Other groups (Figs. 4, 5, 7, 11), not satisfied to take clay, sponge spicules, pebbles and the finished products of their cousins as building materials, construct glass and porcelain compounds, which they fashion into solid, highly-finished domiciles. (See "Nature's Geometric Workmen," by the present author, SCIENTIFIC AMERICAN, December 27th, 1919)

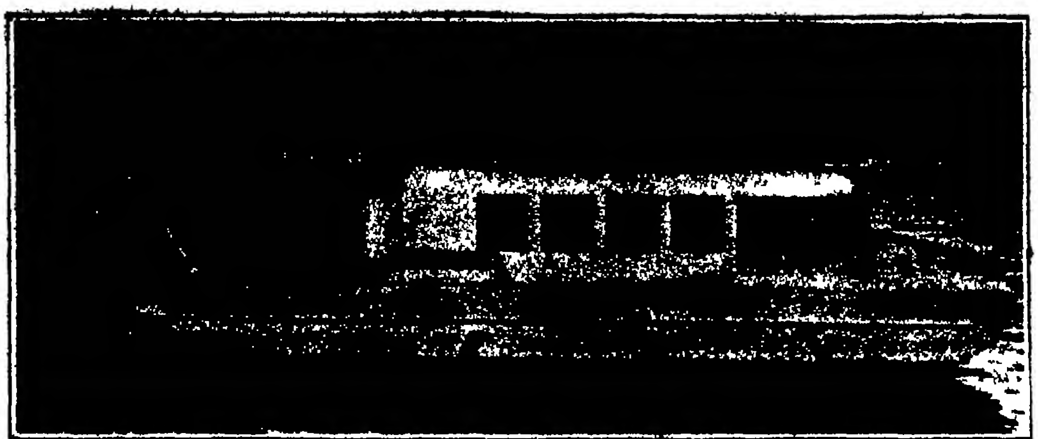
What are the tools—the hands, the eyes, the brain—that enable a difflugia (Fig. 9) first to gather the transparent quartz pebbles with which to construct its home; second, to arrange the pebbles in their orderly fashion, third, to hold them in place while the cement that binds them is hardening? It has been seriously suggested that man is superior to other animals only because of the shape of his hands. Here we have an extensive family of several thousand varieties, each species having a tribal instinct to build a definite-shaped home, without the aid of hands, or, apparently, of any organs whatever. Each artisan uses the same material, the same ornamentation or color, the same plan and dimensions. Can anything be more confusing, not to say contradictory, of the common conception that it is brain in an animal that enables it to do these things?

1 Eozoon Canadense 2. Reophax Difflugiformis 3 Ameba Proteus—above, resting; below, active stage. 4 Anomalina Oriminensis. 5. Uvigerina Pygmaea. 6 Technitella Melo, with section of a single cavity 7 Cristellaria Echinata. 8 Bigenerina Robusta, and a section with cavities. 9 Difflugia Pyriformis. 10. Trohammina Coronata 11 Cristellaria Trisurinella

Some typical specimens of the rhizopods and foraminifera

The Latest in Speed Boats

SOMETHING a little bit different, in the speed-boat line, from the conventional gliders and scooters is the French creation illustrated at the top of this page. The craft is of such very light draft as almost to justify the statement that it "sits on top of the water." In this respect it is, of course, little different from most other speed boats; but the manner of its propulsion is more that of the true hydroplane. It is, in fact, provided with two airplane engines which drive air propellers rather than water propellers, just as in a regular plane. The little speeder will make 45 knots when loaded to its designed capacity of five tons, when light it has been coaxed up to 60 knots. At such speeds we may probably assume that it really does rise out of the slight submergence which it normally posses, and rides the surface much after the fashion of a true plane.

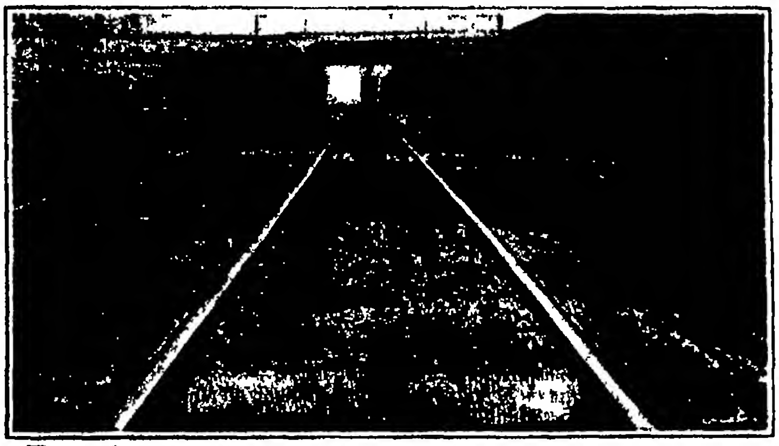


A new French "water glider," which combines aerial and marine practice in a somewhat unusual way

The All-Steel Grade Crossing

TO replace wood or concrete road-crossings over railway tracks a crossing formed of steel plates has been perfected by an Iowa manufacturer. The crossing is made of wrought steel plates supported on the tie by angle plates of sheet steel. They fit between the rails snugly, flush with the top and have a flanged groove for the flange of the car wheels, the edge of the plates fitting tight under the ball of the rails. Lag screws driven into the ties hold the crossing securely down, enabling it to be removed or set back in about 10 minutes.

It is claimed that this type of crossing is self-cleaning and that mud, gravel snow, sleet or ice will not accumulate on the ties. The ties are kept continually dry because of a current of air circulating all the time between the crossing plates and ties and the further protection of the crossing plates. This thorough ventilation gives a freedom from freezing and thawing, which ruin many crossings.



The steel-plate railroad-highway crossing which is designed to eliminate the usual maintenance difficulties

An Electrical Theory of Memory

IN the *Journal of Comparative Psychology* for June 1921, Dr G W Crile presents what may be called an electrical theory of memory. If we assume that the organism is an electrochemical mechanism by means of which potential energy is transformed into kinetic energy in the form of heat, muscular action, and electricity, through the coordination of certain organs, then Dr Crile asks, how do stimuli which vary so greatly in their nature and in their intensity reach the brain through the vast numbers of delicate receptors of varying kinds, find their way through the intricate paths of the brain mechanism, and produce each its specific response? That is, how is it that light waves always activate the rods and cones of the retina; the coarser waves of sound, the organs of Corti, the infinitely attenuated particles in the air, the receptors in the nose? How is it that the activation of these receptor mechanisms, so delicately attuned to such infinitely small waves of motion and of chemical action, can cause responses as powerful as those produced by the gross injury of tissue?

In answer to his question, Dr Crile finds that the brain mechanism is operated by electricity. As Mathews suggests, he supposes that all cells are electric batteries. Hence, the large cells in the fundus of the eye, connected with the rods and cones, may be regarded as batteries, attuned to be discharged by the electric energy created by the action of the ray of light on the rods and cones. Nernst first proposed and many physical chemists have accepted the theory that stimulation is not due to a continuous flow of electricity, but that interposing membranes must first be polarized by the accumulations of ions, stimulation taking place when a sufficient accumulation has occurred. If this theory be true then a quantitative element is admitted so that one may suppose that the semipermeable membranes, in the case of the feeble electric current set up by a light wave, offer a correspondingly feeble resistance to be overcome before stimulation is achieved. Once the first cell in the path of the electric current is stimulated, and its electric charge is added, then the charges of the other cells lying along the base of the retina will be "fired" with great rapidity augmenting the current.

In this connection, it is at least interesting to note, Dr Crile says, that the cells which are connected with the rods and cones are both large and numerous, whereas the nerve endings which act as receptors for physical injury, such as the sensory nerve endings in the skin, have almost no accumulators in the form of nerve cells to reinforce and augment their stimulus. The inference is that the infinitesimal receptor of the eye which receives a beam of light of infinitesimal power has made up for the want of initial physical force by adding a group of accelerating batteries. Were there a set of accumulators in the skin as powerful as those in the eye endless explosions of energy would result. It is as important that the nerve receptors in the skin should have scant accelerating batteries to minimize the strength of the force in their specific stimuli as it is that the eye should have powerful accelerators to augment the infinitesimal physical force of its specific stimulus. It is of interest in this connection to note that Nissl found that the cells at the base of the retina became exhausted when the eye was long exposed to sunlight. Precisely similar changes are found in the brain-cells generally as the result of a crushing traumatic injury. The blindness produced by sunlight is comparable to the loss of the power to produce body heat, muscular work or mental action which results from body wide trauma. Body wide prostration is traumatic shock, sun blindness is sunlight shock.

As the passage of electricity through the eye causes the sensation of light, so the passage of electricity through the ear causes the sensation of sound.

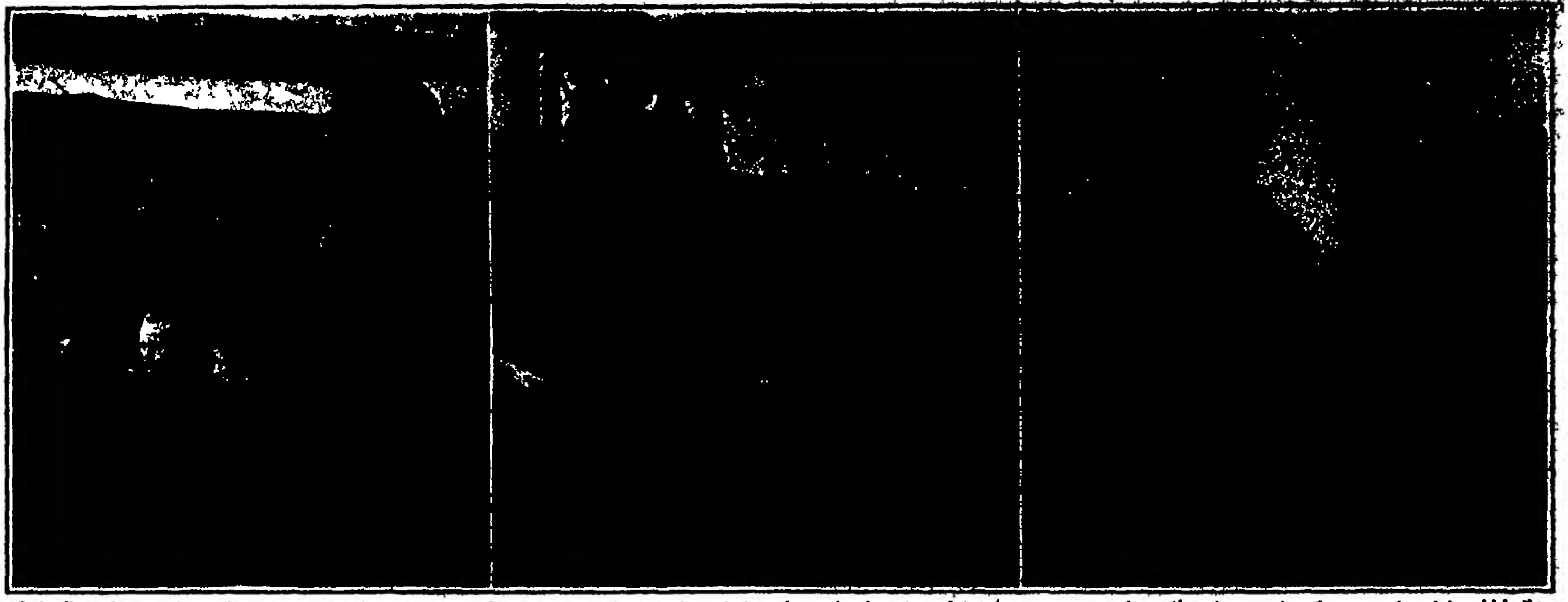
Dr Crile then develops the theory that the white matter functions as a phonograph matrix upon which each incoming stimulus has made its electrical record. When the brain cells are again roused to action by a repetition of any one of the stimuli which has traced its original record the outgoing electric impulses released by the stimulus traverse the facilitated path and reproduce the original action. Just as a phonograph record will give back the same words or tune in after years so Dr Crile conceives varieties of magnetic phenomena to be written on the white matter the recording tissue which is the matrix upon which the action patterns are written.

Long-Range Engineering with the Aid of a Model

IN planning the mixing and chuting plant for the construction of the Barrage de Barberine a hydroelectric development in Switzerland, it was found that many of the engineering difficulties would be solved through building an exact model of the site and then erecting the plant to scale. A contour map had fortunately been furnished the American firm and with this as a guide the contour of the ground was reproduced in clay. Then the towers guy lines, cables and chutes were all built to scale and placed in the exact positions that they were destined to occupy.

When this model was finished it helped wonderfully in solving the problems that had puzzled the draftsmen. The clearance required by a cableway the location of the guy lines the use of single or double guy lines, the bracing of the towers—these and many other points were made clear through the use of the accurate model. There was also the satisfaction of knowing that when the plant was finally installed the layout would be correct and the plant would function properly.—*By Geo F Paul*

This model, constructed from a topographic map, reduced to their simplest terms the problems of designing, in America, the plant and equipment for a Swiss water-power project



Left: Transferring the mail from truck to plane *Center:* No time is wasted on landing; before the engine has stopped turning over, a man is on the wing opening the compartment in which the mail is carried *Right:* Safety first in starting; one man spins the propeller and two others help and then snap him away from the suction which it sets up

Typical scenes at the air-mail landing fields here in America, proving that we are going ahead in peace-time aviation

Why the Mail Plane?

The Things That Make This Daily Flying on Schedule Worth All It Costs, and More

By C. H. Claudy

WHEN the air mail routes were first established, there was a great deal of hurrah made over them. Little by little they have faded out of the public mind—and some of them out of existence altogether. Nevertheless, in spite of the utter absence of furore about it, the mail pilots are flying every day over the route from New York to San Francisco, flying on schedule and in every weather save actual storm—flying in weather in which it would two years ago have been considered suicidal to attempt a flight. In this story Mr Claudy tells us what it is all about and, as his sub-title indicates, why the experience being gained by these hardy pilots is worth far more than it could possibly cost. To his question whether air mail should be extended there can be, we think, but one answer —THE EDITOR.

WITH a million and a quarter annual appropriation for the air mail service, it is not possible at present prices for labor, material and supplies, to do more than maintain the transcontinental mail service authorized by law If we are to have more air mail service, we must spend more money Whether that "more money" is justified or not is not a matter of opinion, but a matter of facts.

Here are some of the facts

Aviation now, like railroads half a century ago, is finishing its first experimental period, and entering upon its era of extended commercial use. The railroad system of the United States leads all the world in trackage, in speed, in comfort, and, in its larger units and as a whole, in efficiency in ton miles per unit of cost. That these things are so is a direct result of that government subsidy and encouragement given the railroads in their early days, through land grants and other privileges.

Aviation is too expensive to be developed by private capital, unless that development is extended over a very long period of years. Without government help, aviation will develop, but it will be done by a private company here, a courageous group there, a daring flyer "on his own" the advertising genius of some spectacular newspaper-contest manager Such agencies must necessarily take time During that time other countries are developing aviation rapidly through government aid

It is unquestionable that mail transportation *via* plane is expensive compared to the same transportation *via* rail No postal authority has ever yet been able to decide what proportion of two cents an ounce per letter went to pay for carriage, and what percentage paid for overhead, it is unlikely that such a decision will ever be final, since carriage charges differ so for almost every letter But whatever the proportion it is vastly less in rail than in plane So much is freely admitted at the start.

But the end and aim of the mail service via plane is not only carriage of letters. Let that fact be firmly put in mind and kept in view the speedy carriage of first class mail is the *postal reason* of using a plane for mail transportation but the government aim is at a higher target That target is, briefly, the creation and keeping fit of a competent body of flying men, the creation and keeping fit of a fleet of up-to-date planes, the creation and keeping fit of a practical and useful equipment of flying fields, wireless, corps of mechanics, and airplane repair and constructive shops, and the continual collection of data regarding flying in all weathers, in all directions, in all winds and temperatures in all our latitudes.

Mail flyers fly according to schedule. There is the crux of the matter as far as airplane information-gathering is obtained. With the exceptions of obviously dangerous or "impossible" atmospheric conditions, the mail flyers leave their terminals at fixed hours, on time, to arrive at their destination at or about fixed hours. One or two flights under such circumstances may tell little, when the miles so flown come to be measured in millions, averages of conditions and extremes of possible conditions are obtained which become the basis and which are the only possible basis for an exact knowledge of the atmosphere as it affects flight, and continuous flight under all conditions as it affects engines and planes and all the delicate parts thereof

There is no guesswork in the operation of mail service via plane. Exact statistics are kept of every performance, and thus of average performances. Let us look at a few of these For the 31 months from May, 1918, to November, 1920, mail planes flew 1,211,765 miles. They carried 1,244,194 pounds of mail (49,767,-760 pieces) at a cost of $1,246,006.60, which includes 6 per cent on the investment and all cost of rebuilding crashed planes and repairs, but not depreciation of planes, as most of this is charged to discarded surplus war material.

The average performance, by months, was 88.98 per cent perfect For twelve months the performance was from 95 to 100 per cent, for two months from 69 to 70 per cent; and the balance of the time is reported in 4-month periods, which were, respectively, from 75 to 80, 80 to 85, 85 to 90 and 90 to 95 per cent perfect.

During this period there were 812 forced landings, 446 due to motor trouble and 366 due to weather. Both causes are as yet to some extent unavoidable, but both results are being made smaller Liberty engines, used almost exclusively, give less and less trouble as the period between overhauls is adjusted to the individual flight conditions, and weather-forced landings grow less as men learn the better to judge conditions. It is of interest to note that the averages work out to prove that a flyer can count on 2717 miles of mail flying to every engine-trouble-forced landing, and 3311 miles of mail flying for every weather-forced landing.

The cost of mail flying is· overhead (which includes departmental salaries, freight and travel, printing and incidentals, radio, telegraph and telephone, 6 per cent interest on investment and 16 2/3 per cent depreciation on equipment other than planes), 12.59 cents per mile; field operations, including gas, grease and oil, office force, motor cycles and trucks, rent, heat, light, telephone and water, pilots, mechanics and helpers, repairs and accessories and miscellaneous, 88.92 cents per mile; losses (crashes and fires), 34.6 cents per mile of flight. These are 31-month averages. Many recent months reduce this, for instance, September of this year shows an average of but 70 cents for total cost, including testing and experimental work.

At the present time but one line of mail service is in operation· New York to San Francisco. It goes via Cleveland, Chicago, Omaha, Cheyenne, Salt Lake City and Reno. It requires two and a fraction days in summer and three and a fraction days in winter to make the trip, taking longer coming east than going west. The time saved in the mail transportation is perhaps best illustrated by a single leg of the journey. In a record flight made by mail planes between Salt Lake City and San Francisco on Friday, October 14th, the time consumed from take-off at Salt Lake City (5.32) to arrival at San Francisco (11.33) was six hours and one minute, Service stops were made of 11 minutes at Elko and of 20 minutes at Reno; therefore the actual flying time was 5 hours and 30 minutes. Train No. 9, the fast exclusive mail and express train operated over the Southern Pacific Railroad, has a schedule of 24 hours and 15 minutes between Salt Lake City and San Francisco.

"Air mail statistics are not compiled to make a showing, but to furnish dependable data to persons desiring

to enter the field of commercial aviation," says the Post Office. "The data must be safe to make them of value; for this reason the statistics are reviewed at the end of each year and checked against the audited and outstanding bills for the service. For this reason, likewise, the air mail service has inclined toward a liberal rather than a close valuation of its investment.

The per-mile units of cost in the air mail statistics are all based on the substantial scale of one million or more miles of operation. On such a scale they may be depended upon as reliable averages for the type of planes and the character of operation which they represent, that is, flying daily under rough field conditions, with all manner of forced landings and in all kinds of weather.

The total investment of the air mail service is $743,-450; $133,450 for buildings, trucks and tools, and $610,-000 for airplanes. The buildings, tools and planes purchased are charged at the prices actually paid for them. The tools and trucks transferred to the air mail service without cost, out of the surplus war stock of the Army, are charged at the price at which they could have been purchased in the market. The airplanes which were transferred by the Army to the air mail service out of the surplus war stock are charged at their original cost to the Army. Had they been charged at the market price for such surplus war stocks the value of the equipment would be possibly one-half of the value at which they are carried on the books of the air mail service.

It is not a particularly safe game, this airplane mail carrying. The great enemy is fog at landing, and only a reliable and definite signal which can penetrate fog, or a plane which can settle to a landing rather than slide down to it at speed, can eliminate this danger. So far we have a record of one fatal accident to a pilot for every 124,048 miles flown and one fatality to a mechanic for every 322,525 miles. The percentage of mail damage is one-tenth of one per cent.

Every possible precaution is taken to conserve life. Pilots are not required to fly when conditions are bad. They go up, with the mail, if, when they are up, they find conditions such as to make the flight dangerous, they return. The best of planes, frequent engine overhauls, good fields, the best of maps and flying directions, a network of wires and wireless for weather information, a daily report of each flight made, not only make this *on-schedule-flying* as safe as may be, but make this mail service the greatest collector of data on safety in flight which this country possesses.

The facts here presented could easily be used as an argument against the need of extending the air mail service, for the benefit of the taxpayer. They can as easily be used as arguments for extension, since we all know that speed of mail transportation makes for better business and more of it. No argument is needed to show that if we can afford it air mail service will cut the time of mail transportation down by a large percentage.

But whether, from the postal standpoint, we can afford it or not, it seems obvious *we can not afford to do without it, greatly enlarged, from the standpoint of national defense and a national expansion of business, via aviation.* In the writer's view this leaves nothing to be said against aerial mail extension.

Let us hope we never have another war. If we ever do, it will be largely in the air. The more we are "in the air" in advance, the less likely, then, we are to have another war. If we must fight, a nucleus of flying fields, trained personnel, available planes and practical flight data will be invaluable.

At present our aviation interests are commercial. How to make the plane a freight carrier, how to put wings to business as we put them to war and letters, is the greatest scientific business problem before us. And at the present time we are governmentally aiding in the solution of it only with a single east-to-west line. We need north-and-south lines. We need diagonal lines. We need a network of air mail lines—not merely one transcontinental line. They can't begin to cost us what they are worth to us.

Hence, for you who read, and those who sit in Congress and appropriate, the question to be answered is not only "is this form of mail transportation worth what it costs in terms of mail?" (and, by the way, the postage on the mail so carried much exceeds the cost of carriage), but, in terms of aviation, in terms of knowledge gained, in terms of encouragement to and development of commercial aviation, isn't it worth so much more than it costs in money that the United States can not afford to do without the rapid and great expansion of its air mail service?

Air-mail plane being tuned up and warmed up preparatory to the take-off

Form

Division EASTERN

DAILY FLIGHT PERFORMANCE

Second Assistant Postmaster General
AIR MAIL SERVICE

MAIL FLIGHTS

Headquarters New York Date October 14, 1921

Weather	Ship Number	Aviator	From—	To—	Left	Arrived	Time: Hours	Time: Min.	Mail Received: No. of Pouches	Mail Received: Pounds	Mail Dispatched: No. of Pouches	Mail Dispatched: Pounds	Mail Accepted at Field	Remarks
Hazelhurst ceiling 1500 ft.	[illegible]	[illegible]	N.Y.	Bellefonte	706	1036	3	30	10	[illegible]	1	4		(a)
visibility 15 miles	[illegible]	[illegible]	Bellefonte	Cleveland	1046	100	2	15	1	4	10	[illegible]		(b)
CLEVELAND partly cloudy	[illegible]	Smith	Cleveland	[illegible]	[illegible]	[illegible]	2	01	11	[illegible]				(c)
			[illegible]	Bryan	[illegible]	[illegible]		40						(d)
			Bryan	Chicago	[illegible]	510	2	10			11	[illegible]		(e)
														(f)
[illegible] Ceiling 5000 ft.	94	Jones	Chicago	Bryan	[illegible]	1250	1	18	10	403				(g)
visibility unlimited			Bryan	Cleveland	[illegible]	137	1	08			10	403		(h)
BELLEFONTE ceiling	[illegible]	[illegible]	Cleveland	Bellefonte	[illegible]	915	2	11	10	400				(i)
unlimited ground fog	[illegible]	Lewis	Bellefonte	N.Y.	[illegible]	1151	2	[illegible]	1	4	11	404		(j)
														(k)
														(l)
					Totals				45	1363	45	1363		

A sample of the reports by means of which strict account is kept of all the essential data connected with flying on schedule

Rats Invade Oceanic Island

UNTIL three years ago Lord Howe Island, 300 miles east of the Australian coast, was entirely free from rats. Then some rats came ashore in the cargo of a stranded vessel and they have completely upset the balance of nature. They swarm all over the island and bid fair to exterminate most of the land birds, including the woodhens *(Ocydromus sylvestris)* which are confined to the island and find their nearest allies in the wekas and kiwi of New Zealand, which they resemble in being flightless. This they do by devouring the eggs. The rats also eat the seeds of the thatch palm (*Howea fosteriana*), a species peculiar to the island. These seeds, from which are grown most of the table palms of the world are the chief and almost the only export of the island. So far no means have been devised of dealing with the rat plague

Populations and War

IN the first volume of *Metron*, a new Italian periodical devoted to the science of statistics, Mr G H Knibbs discusses the theory of large population aggregates. Any large population group, Mr Knibbs says, must necessarily tend at each moment to increase according to an exponential law with a positive index, and the rate of which initially may accelerate. In all cases this rate must ultimately decrease, until it becomes zero

In order to realize what must be the general history of large population aggregates we need to develop a method by which we can anticipate what may be the normal development Accessions of knowledge, however, and widespread changes in regard to standards of living can operate to produce sharp changes in population facts After these have transpired they *may* be regarded as furnishing, as it were a new datum value from which the future may be considered The result of the increase will always be that the limiting density corresponding to the totality of existing conditions is more quickly approached, and, as it is approached, it becomes more and more difficult for the same rate of increase to be maintained Ultimately it can not be maintained, and as soon as this is the case collision with neighboring population groups is inevitable These are unavoidable so long as any group regards itself as entitled to expand irrespective of the rights of adjoining groups. Such *collision* is, of course war, and war is inevitable unless concerted action is possible, the object of which is to come to a common agreement as to rate of increase This can be reached only with a high state of discipline and knowledge The present population of the world and its recent rate of increase, is such that it can not be maintained even for a few centuries, since it may easily be shown that no possible accession of food supplies could meet the requirement

Even a very moderate rate of growth can not indefinitely postpone trouble, and a people can save itself in this respect, only in so far as they can increase their *efficiency to the highest possible limit, and also restrict* themselves in regard to all unnecessary luxury. Whatever advances are made in science, and its applications in industry and in food supply, they can not of themselves postpone the ultimate resistance to further development, which must inevitably increase

Pouring Concrete Under Water

Barge Canal Dock Walls at Buffalo Built Without the Use of Coffer-dams

A NOVEL and highly successful method of building concrete dock walls is being used in the construction of the Ohio Basin at Buffalo for the New York State Barge Canal. The novelty consists in the substitution of large and massive steel forms for the coffer dams which are customarily used in building subaqueous walls.

In building under-water foundations, whether bridge piers, dock walls or the foundations of office buildings which have to be built in water bearing strata, it is customary to construct coffer-dams or caissons of the approximate size and shape of the foundation, excavate the material from within the structure, either by open dredging or by forming a bottom working chamber and using compressed air and then building up the masonry or concrete within or upon the structure until it has been carried above water level and to the finished height.

A stretch of the concrete dock walls built under water without the use of coffer-dams

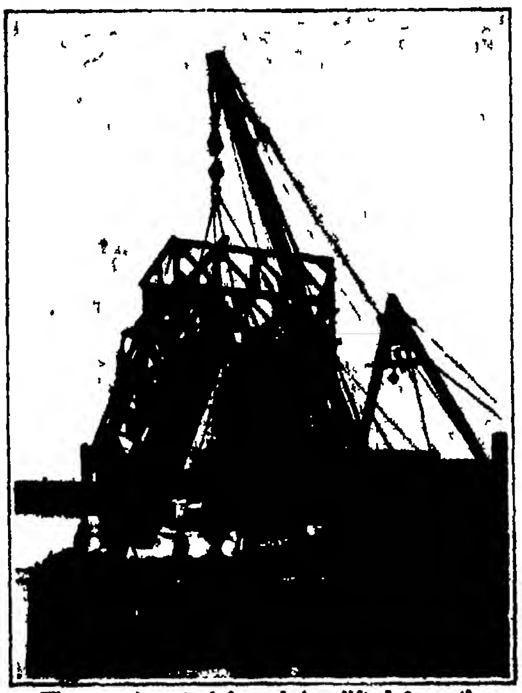
Now this is a tedious and expensive process, and it occurred to Mr. F. C. Hibbard, engineer and superintendent of the work at Buffalo, that since the wall was to be built of concrete it could be done more expeditiously and at less cost, if it were built in sections and if each section were poured within heavy steel frames extending from the bedrock to and above the surface of the water. The very interesting steel structure which is shown in our illustrations was designed for this purpose and has done the work with great satisfaction both to the contractors and the state engineers of the Barge Canal.

The part of the Ohio Basin with which we are concerned in this article is a concrete wall 1550 feet in length, which rests on the rock at a depth of from 21 to 28 feet below mean water level, the finished wall being from 28 to 35 feet in height.

The concrete form is carried within a deep and very rigid frame of the character shown in our illustrations, which is sufficiently larger than the concrete wall to enclose it and still leave room for the adjustment of the forms. The forms for the front and back of the wall are suspended from the top of this frame, and they are held in the desired position by means of screw jacks and toggle arms. These adjusting appliances are such that the distance between the forms and their inclination can be adjusted with great nicety. Heavy jack screws serve to give the necessary vertical adjustment.

Each end of the forms is closed by means of a bulk head which is attached to the forms by means of lugs. The lower part of the forms is built of timber. This is done in order to accommodate the forms to the varying depths and irregularities of the contour of the rock below. The first sections of the wall were poured where the water depths was greatest, and as the depth reduced the bottom timbers of the forms were removed. When the form is submerged it rests on four posts, one on each corner of the enclosing frame, which are adjustable in a vertical direction. As soon as the form is in place the surface of the rock is cleaned by means of a centrifugal pump the mud having been first loosened by the use of water jets operated by divers.

The wall is constructed in 20-foot lengths, and when the concrete has been poured and has been allowed 48 hours to set, the form is loosened from the face of the wall by means of the jack screws and with its enclosing frame, is lifted clear of the wall and placed in position for the next section. Mr. Hibbard, manager of the Great Lakes Dredge and Dock Company informs us that he has built 75 feet of complete wall in six days, and that this is something that would have been absolutely impossible had they used the coffer-dam method. That would have involved the various operations of driving sheathing, bracing the coffer-dam and excavating the material inside, cleaning off the rock, building forms, pouring concrete, waiting for it to set, removing the forms and removing the coffer-dam. These many details of operation are eliminated by the new method. Two hundred and eighty yards of concrete are placed at one pouring and, of course, the form and its frame had to be built with a special view to resisting the heavy pressures while this mass was in the liquid state. In some of the first blocks a manhole two feet in diameter was placed in the center of the form down to the rock foundation. At the end of 48 hours after the pouring was complete this manhole was pumped out with a view to examining the concrete blocks from the bottom to the top. It was found that concrete placed in the water with a bottom dump bucket was equal to any concrete with which the company had had experience either on dry land or in water.



The massive steel form being lifted from the working barge

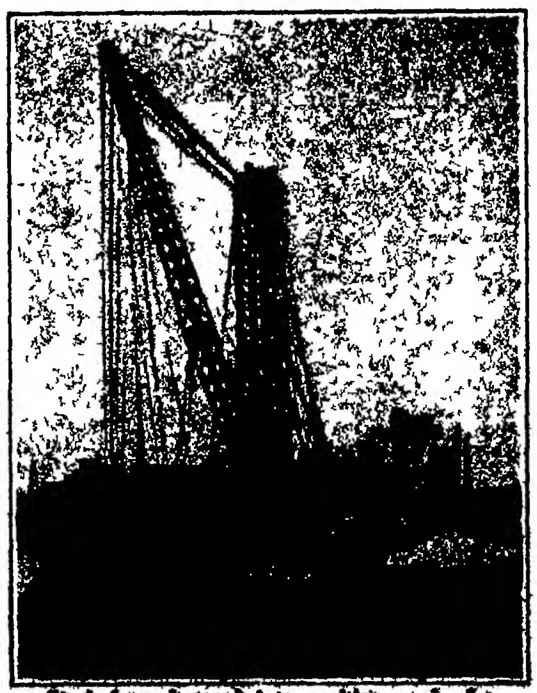
Capacity Effects in Inductance Coils

A COIL of wire wound in any of the familiar forms called "inductance coils" behaves in an electric circuit primarily as an inductance. The potentials of the different parts of the coil are, however, different from each other and from the potential of the ground. For this reason the coil also behaves to a certain extent as an electric condenser, or rather a system of condensers. These capacity effects of inductance coils are particularly important at the high frequencies employed in radio communication. The effective capacity of an inductance coil depends in general on the capacities existing between parts of the coil and the ground.

On account of the importance in radio communication of capacity effects in inductance coils, careful studies of these effects, both theoretical and experimental, have been made at the bureau. An interesting result which has been found is that one effect seems to depend primarily on the capacity of the coil to ground. This effect is observed when two condensers in series are connected across the terminals of the inductance coil, and the common terminal of the two condensers is grounded. If the inductance coil possesses capacity to ground, the familiar formula for resonance in the system, computed from the known values of the capacities of the two condensers, will not apply.

If both condensers are variable and the system is adjusted for resonance by successively assigning arbitrary values for the setting of one condenser, and then tuning with the other condenser, it would be expected from elementary considerations, neglecting the effects of distributed capacity, that the successive resonance values of the capacity of the two condensers in series, determined as the product of their capacities divided by their sum, would be constant. On account of the distributed capacities, this simple relation does not hold. It is found, however that under the conditions above mentioned, with the common terminal grounded, the capacity of the two condensers in series determined as the product of their capacities divided by their sum is linearly related to the reciprocal of the sum of their capacities. This relation has been verified both mathematically and experimentally.

The results of both the mathematical and experimental investigation of this particular phase of the problem of capacity effects in inductance coils are given in a publication of the bureau which has just appeared, Scientific Paper No. 427, "Some Effects of the Distributed Capacity between Inductance Coils and the Ground," by Gregory Breit. Copies may be purchased from the Superintendent of Documents, Government Printing Office, Washington, D. C., at 5 cents a copy.



Steel form lowered into position ready for pouring the concrete

What and Why Is a Contour?

By S. R. Winters

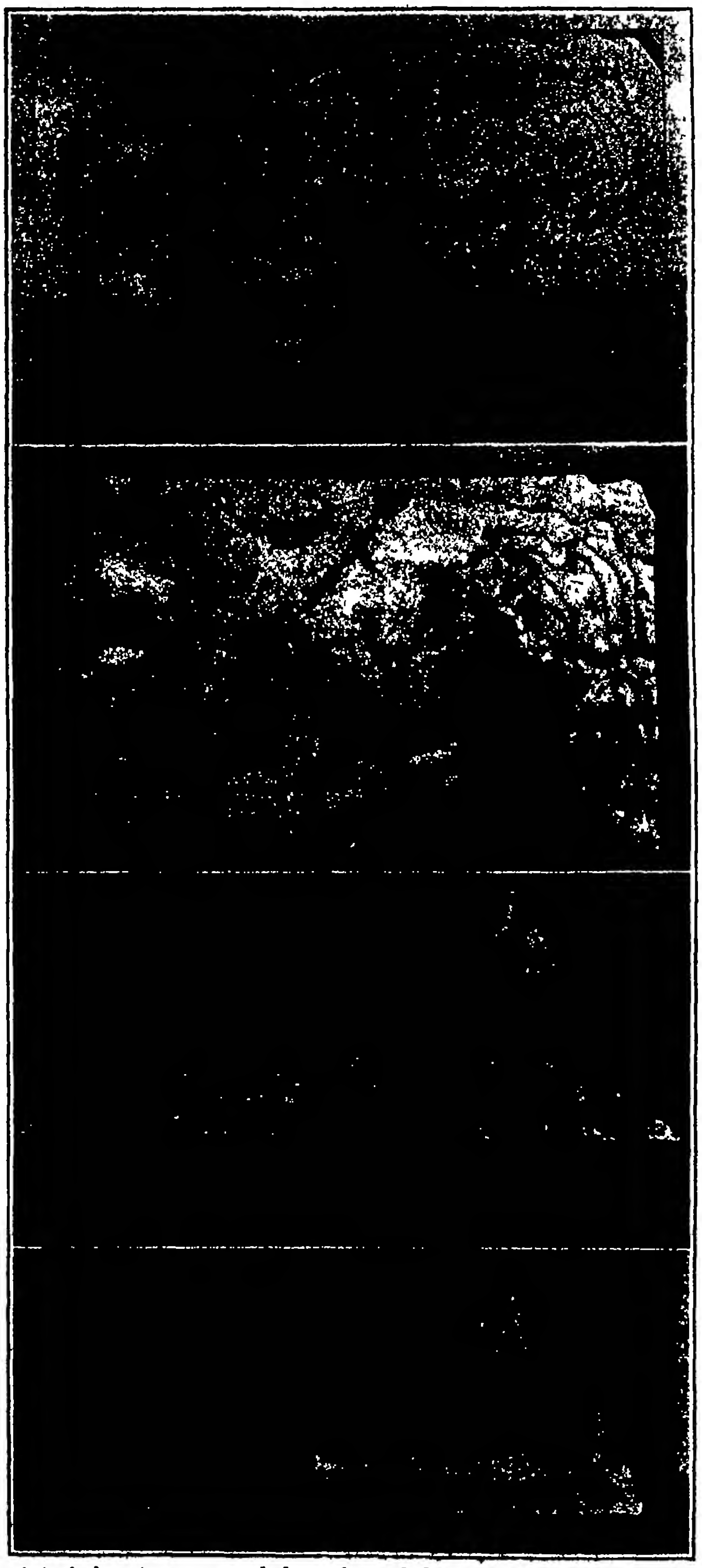
THE question "What is a contour map, and what does it mean?" comprises an inquiry which has prompted M. W Talbot of Albuquerque, New Mexico, to design for the United States Forest Service the first working model showing the meaning and purposes of a contour map. Instead of a single model, however, this ingenious device is a series of models, unfolding in progressive fashion, the significance of a contour as it expresses altitude, shape, and grade of an object. These three elements, when visualized, are accepted as a correct definition of topography, or, in the parlance of the street, the "lay of the land."

This graphic way of answering the question "Why is a Contour?" is accomplished by a mass of pliable substance mounted on a thick piece of wooden board. The model, representing a mountain, is one foot long, and the supposition is that one-half inch equals one hundred feet. Sea level, as we compute height in topographic terms, is always zero So, this working model begins its story by the use of a knife, representing a gigantic carving implement, cutting in a horizontal plane 100 feet above the imaginary seashore line. This is demonstrated in one of the photographs. Having slashed the miniature mountain into layers 100 feet thick, the results are portrayed in the other illustrations of the group

The thickness of these slices is not arbitrarily fixed at 100 feet, variations therefrom might be dictated by the needs of the particular contour map being used. However, a specified thickness is always uniform for any one map That is, the vertical distance between one outline and the next—the thickness of the layer—is the contour interval The knife, in divorcing one slice from another, leaves a crack on the surface of the pliable substance or model which represents a contour line These demarcations are illustrated in the three photographs of the series of models. This graphic presentation of what a contour consists of may be amplified by text which the designer of the clever device has picturesquely done A shore line of a lake, a trail in the snow as one wanders in and out among the forests provided he does not climb or descend a hill, the edge of a flat topped butte, a flume along a canyon wall built by mistake on dead level instead of on a slight grade, and even the hoop of a barrel—these are examples of contours!

Having discovered the meaning of a contour, the logical question is "Of what service is it?" Take another peep at the mountain, which, viewed from an equal elevation, will look just as the third photograph would look if it were all in one piece. Then tilt the model mountain at an angle shown in illustration number four Again another slant sidewise, with a continuation of the tilting process until the big hill is seen from squarely above, looking straight down as in views one and two If one's imagination is more vividly stimulated from the air, observations may be made from a balloon, looking downward on the mountain when soaring directly over the monumental hill. Whether your feet are planted on the ground or you are on a sky-climbing errand, the mountain will appear as shown in our first two pictures. For the former of these is a contour, or, as sometimes described, a topographic map.

The Forest Service has devised another method of bringing out the relation between relief and its representation on a flat surface. The lower slice is placed on a map sheet and a pencil line is drawn around the base—thus, you have a contour line. The process is duplicated with other slices, the general character of the resulting slices being well indicated by the third and fourth of our photographs. The performance is repeated with each of the remaining slices, and the result is another contour map. Both methods, as here described, have succeeded in transforming a mountain into its own topographic map. The first way told about involved the use of our eyes by changing the viewpoint from a like elevation to a point directly overhead. The second method may be defined as a mechanical one, by drawing a pencil around the base of each slice. Thus the clew to what has been happening is revealed. In order to draw a line around the base of slice number four, say, as depicted in our views, it was essential to lower this to the map sheet a vertical distance equal to the combined thicknesses of the three layers which fit below it This lowering performance, if conducted straight downward in the direction of a plumb line, is known as *projection* This kind of projection does not influence the appearance of a contour when seen from above



A typical contour map, and three views of the model which interprets it. Of particular educational value is the one in which some of the levels are displaced vertically. The "contour" interval is 100 feet, so the slices of the miniature mountain represent an actual thickness of 100 feet

Our third photograph illustrates the point with reference to projection vividly Elevate one or more contours and the principle is unchanged That is, if one is in an airplane directly above the mountain it would be impossible to distinguish whether the contour of the fourth layer is at elevation a b, or c In fact, the normal location of the contour shown in this view is at one level, its displaced location at another and its projected location at still another

Finally, contours expressing as they do altitude, shape and grade permit an instant calculation of the approximate height of any point Begin at sea level or zero elevation, count the contours up to the particular one wanted and multiply the count by the contour interval A topographic map, to the user, should mean something more than a jumbled mass of lines or a vague guide to stream direction and mountain location It has been defined by the Forest Service as a near photograph of the 'lay of the land' enabling one to traverse regions hitherto untraveled by the visitor and still know throughout the trip of your whereabouts.

Christopher M. Spencer

HARTFORD Conn papers of January 15th give much space to the death on the morning of the 14th of Christopher Miner Spencer Mr Spencer is one of the outstanding figures in American invention and a shining example of the manner in which great industries are built up on patents Extended biography of him here is rendered superfluous by the fact that his career was rather fully outlined in a special story in our issue of December last Inventor of rifles shotguns automatic lathes screw machines forging processes and a wide variety of other modern machines and founder of one of the largest firms in America manufacturing shop machinery he was in every way representative of the Connecticut Yankee of the best type He was 88 years old and as recently as October last when he was a welcome visitor in our editorial office, he was hearty and vigorous in spite of his years

The Flexible Key as a Prevention of Robberies

A FLEXIBLE key, one that will go into and work in a tortuous hole has been developed in Germany The many robberies that are constantly reported everywhere have created a demand for such a key According to a British writer's description the wards and the bow are not connected by a stiff stem but by four superimposed strands of ribbon steel which prevent any sideways movement when the key comes into play Thus there need not be a straight way between the escutcheon on the front of the door and the actual keyhole in the lock-case, which can be fixed at an entirely different level and the point of introduction for the key is independent of the locking point Between the outside and inside fittings there is a tubular channel with a slit in the bottom to allow the passage of the wards. This channel in German is called "Schlüsselzuführungsschiene" or literally "key-conveying rail," a word long enough to insure the prevention of burglary The housebreaker is unable to determine the position of the locking mechanism, nor can he open it with a false key, a wire brush, or a strip of lead To blast it open is out of the question, as the explosive would fall out through the slit in the keyway made for the passage of the ward The flexible key is not as unwieldy as one might expect, because it can easily be rolled up into a spiral and put into a neat case to fit the pocket of its legitimate proprietor

The Peer of Decorative Hardwoods

Rosewood: What It Is, Where It Comes From, and What It Is Good For

By C. D. Mell

THE undisputed precedence among fancy furniture woods has been conceded to rosewood since its introduction into the world's markets. Manufacturers of the fine styles of furniture and interior trim consider it the epitome of beauty and elegance and the emblem of refined taste. It has been a favorite wood among makers of musical instruments and fancy cabinet work for about 300 years, as may be attested by the amount of antique rosewood furniture that has been handed down from generation to generation.

The word rosewood, as used in this article, has reference only to the genuine kind which emanates from Brazil under the local or Portuguese name of jacaranda cabiuna, or simply cabiuna. This word was introduced into the European markets prior to 1660, and it is believed that consignments had reached France and England during the 16th century. There are evidences that rosewood furniture existed in the mansions of the nobility and gentry during the reign of Queen Elizabeth, for at this time the homes of the rich had acquired a splendor of fitting and finishing which they had not before displayed, and of which abundant evidence is even yet to be seen in some of the well-preserved old manor houses in England and among the exquisite decorative features in the castles of continental Europe.

Before the year 1600 full cargoes of dye woods were shipped out of Recife (Pernambuco) to Europe, and at a somewhat later date similar shipments emanated from San Salvador (Bahia), and among these were logs of rosewood which received the name of palissandre (a word corrupted from palo santo, meaning holy wood) in France, and rosenholz in Germany, because the odor of the wood resembles that of roses.

The earliest records refer to this wood as Pernambuco, which is the name of the province where the logs originated; later shipments emanated from the State of Bahia, and for many years it was known in England as Bahia wood, and a still later name was Victoria wood, so called because the logs were shipped from Victoria, a seaport town in the State of Espirito Santo. The two chief trade names which persist to the present time are palissandre and rosewood, the local binomial, jacaranda cabiuna, is rarely used in the trade. The scientific name is Dalbergia nigra.

The present supply of rosewood logs comes chiefly from regions south of Bahia, Victoria being the chief shipping port for this commodity, and approximately a thousand tons of it in the form of rough logs with the bark and sapwood hewn off are shipped into the United States annually. An equal quantity finds its way into the European markets. This quantity represents less than one-third of the stocks that were exported from Brazil during the days when rosewood was used more extensively than it is now.

The use of true rosewood in the United States has been on the decline for over two decades, and one of the chief reasons for this is that substitutes are now being introduced. Another reason for this is that a large percentage of the logs show serious heart defects and that only a small proportion of the logs produce clear lumber, which is so essential in the manufacture of interior trim and cabinet work. As a result of the increasing number of poor quality logs in the shipments received here, consignments have frequently been rejected by consignees, and on account of the eventual sale of the logs at great sacrifice, the shippers at sources of origin refused to forward further stocks except upon the receipt of firm orders with letters of credit established in their local banks. Dealers and commission houses here have always been reluctant to comply with such terms, and the result was that shipments of substitutes from other parts of the tropics were encouraged. Cocobolo and other so-called rosewoods have taken the place of true rosewood and are now in general use here. Upward of 2000 tons of these substitutes are being consumed in the United States annually. The annual consumption of rosewood of all kinds in this country for all purposes is shown in the following table compiled by the United States Forest Service:

Rosewood logs, cut in half by the pit-saw in the foreground

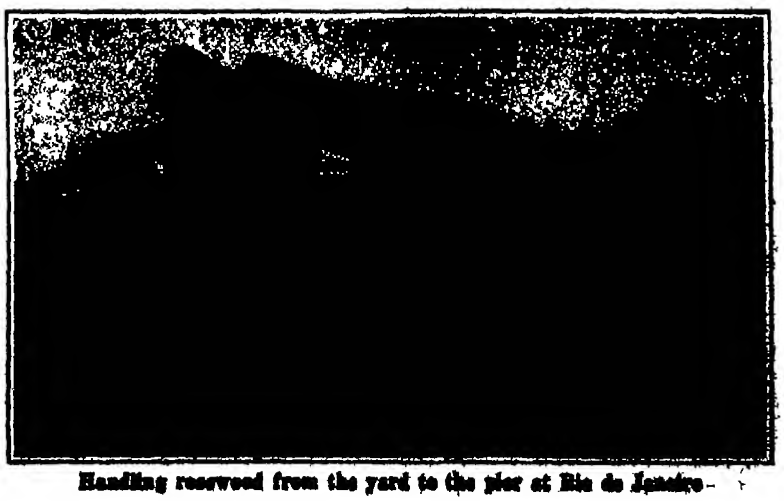
Industry	*Feet board measure*
Professional and scientific instruments	219,452
Fixtures	52,325
Musical instruments	49,645
Railroad cars	37,000
Sporting and athletic goods	24,400
Handles	15,456
Furniture	15,200
Brushes	12,060
Faucets	10,642
Artificial limbs	10,000
Doors and sash	6,100
Carpet sweepers	5,500
Novelties	3,613
Picture frames	3,420
Electrical apparatus	2,300
Boats	1,600
Shade rollers	1,000
Plumbers' woodwork	1,000
Clocks	200
Tobacco	100
Total	471,734

Rosewood logs, showing the common heart defect

The total number of feet given here represents approximately 8000 tons of logs in the rough, which confirms the estimates already made that there are about 1000 tons of true rosewood and about 2000 tons of substitutes entered here annually for consumption.

Rosewood is expensive, which militates somewhat against its more extensive use here, less so in Europe. While the price of true rosewood was about $100 per long ton during the war, it can be laid down now in New York for less than half that figure. But even this is an unusual price for wood when it is calculated in terms per 1000 board feet. It requires approximately five tons of logs in the rough to yield 1000 board feet measured by a standard log rule, but this does not take into consideration the great amount of waste due to defects. At $50 per long ton figured on the basis of board feet it is $250, but less than 200 board feet of this represents clear stock.

Quoting the *Hardwood Record* for October 25th, 1918: "The average price paid during a whole year for rosewood by manufacturers in Pennsylvania was $462.90 per 1000 board feet. The wood is nearly always bought in the log, and if it is purchased by weight, the price is figured on the foot basis. The average price during a year in Illinois was $283, in New York, $219.50, and in Connecticut, $225.40."



Handling rosewood from the yard to the pier at Rio de Janeiro

Petroleum Wastes and Savings

AN investigation of losses of crude oil through evaporation in storage and in transportation, conducted during the year by the Bureau of Mines, disclosed losses of startling magnitude. It was found that in the few days in which crude oil is stored on the lease before being taken by the pipeline the aggregate loss per year from evaporation amounts to about 122,000,000 gallons of gasoline in the Mid-Continent field alone. This has a value, at 22 cents per gallon, of $26,840,000, and represents about 3 per cent of the total gasoline produced in the United States from all fields and all sources. The bureau found that a large per cent of this loss could be prevented by the use of efficient equipment.

The Bureau of Mines has pointed out the considerable losses which have resulted from the failure of many refineries to recover gasoline from uncondensed still vapors. The significance of this investigation is shown by the fact that one refinery in the Mid-Continent field is now recovering from still vapors approximately 400 barrels of gasoline daily that before the installation of this equipment was either lost or burned as fuel under the boilers and stills. The value of fractionating towers at petroleum refineries, by means of which some companies have increased the yield of gasoline from crude oil by as much as 5 per cent or 16 2/3 per cent of the total gasoline yield, has been demonstrated.

Large quantities of gas are now being wasted in the Osage Nation in Oklahoma because of low-pressure conditions, and the Bureau of Mines is investigating the feasibility of utilizing this waste gas by the use of low-pressure burners for oil-field boilers. The demand of the export market for "sweet" gasoline led to the development of a process for treating gasoline to remove the objectionable sulfur compounds, by which treatment some grades of American gasoline heretofore objectionable were made suitable for export.

Under the arrangement by which supervision of the drilling and production of oil and gas on the public lands is vested in the Bureau of Mines, the bureau has supervision of about 100 producing oil properties which are producing at the rate of about 12,000,000 barrels of oil per annum. A special process, devised at the San Francisco station of the bureau, for cracking heavy oils and tars promises the recovery of large yields of gasoline and other lighter products hitherto regarded as unrecoverable. Investigations made by the bureau in Colorado and Utah indicate that the oil-shale deposits of the Rocky Mountain States contain a potential fuel supply of almost unparalleled importance.

Packing Perishable Foods in Inert Gas

ARGUMENT is superfluous in support of the proposition that oxygen must be excluded from canned foods of every variety. Until recently there has been equally little argument how to effect this result. Every housewife knows that canned foodstuffs can be so put up as to exclude the oxygen in the first place. At present the ordinary commercial method of achieving this has been to pack the cans, jars, etc., in the presence of vacuum. This process requires heavy machinery, and it is subject to the further inherent drawback of placing on the market a container made with comparatively light seams and under a continual pressure of 15 pounds per square inch.

A new process has been developed of recent months by Messrs. T. M. Rector and Dwight Tenney, which instead of packing in vacuum is based upon packing in an inert gas. Theoretically nitrogen and numerous other gases would be available, practically carbon dioxide is as good as anything else, and far cheaper It stands to reason that food packed in carbon dioxide will be as free from spoiling as food packed in vacuum Moreover, taking normal atmospheric pressure as 30 inches, a 28-inch vacuum would contain oxygen to about 1.3 per cent of the normal air capacity of the space involved, whereas, if the air be exhausted and replaced with inert gas, and this process be repeated a second time (double exhaust), the oxygen present is but 0.2 or 0.3 per cent of the normal capacity of the space At the same time inside and outside pressures are in approximate equilibrium

This equilibrium has itself numerous collateral advantages. It permits the sterilization of the contents, when necessary, under steam pressure It also makes it possible to pack a container of any size whatever, which is far from the case where every face of the container must be a bridge capable of sustaining 15 pounds load per square inch. Moreover, aside from the better elimination of oxygen, the presence of the carbonic acid gas plays itself a beneficial rôle This gas does not destroy micro-organisms, but it does to a very large degree inhibit the growth which can easily be supported, in its absence, on the residual oxygen left by any commercially practicable method of exhaust

The exhaustion of the air and its replacement by carbon dioxide, however, is on the face of the returns a process calling for machinery of a rather ingenious order Our photograph shows that this demand has been well met The cans come from the sealing machine with a small hole remaining open in their tops. They are carried by conveyor belt, without human handling, and placed one after another under the working heads of the gas machine—one can under each head.

These heads appear in our photograph arranged about the circumference of a circle at the right of the operative. It will be observed that each head carries a spring. This enables the head to come down hard on the top of its can, and grip it in an air-tight grip. The head then travels about the circle until it has completed about three-quarters of a revolution. It then releases the can, which is swept out of its path by an ingenious cam action and passes to a discharging conveyor

It is while the can is in the grip of the working head that the air is exhausted and the carbon dioxide filled in in its place. Two pipes lead to each working head, one coming out horizontally from the central upright around which the instrument revolves, and one swinging down in a curved line from above, as seen in the view. One of these tubes to each working head carries vacuum, the other carries carbon dioxide. The vacuum works during the first part of the can's swing around the circle; it is then automatically cut off and the carbon dioxide then comes into play, the gas flowing from the cylinder seen at the right foreground. Both exhaust and intake work through the little hole left in the top of the can.

As soon as the air is out and the dioxide is in, the can reaches a point in its travels where the working head automatically releases it and it is pushed off to a second conveyor, which carries it past the operative. The latter seals the hole with his soldering iron and a dab of solder; the dioxide is sufficiently heavier than the air

Packing perishable foodstuffs in carbon dioxide

to insure that no significant amount of it will escape from the can during the moment between its release from the intake tube and its sealing. This hole is of such diameter the can may usually stand in air for one minute, or more, before sealing. And that is all. The machine is producing daily, under actual factory conditions, over 25,000 cans, filling them so that the air space contains less than 1½ per cent of oxygen, with the balance CO_2, nitrogen, etc. The cost, including all labor and materials, is less than 0.1 cent per can It might seem that in the case of foodstuffs in which the particles may be smaller than the vent in the can, the exhaust tube would clog after a while and the machine have to be shut down for cleaning, but no serious trouble of this sort has been met.

This process has been tried out with a large variety of foodstuffs. Dry milk, chocolate, cocoa flour containing shortening, nuts, coffee, semi-dried fruits crackers, bonbons, and the whole list of vegetables, etc which are ordinarily met canned, have been put up in this way with universal and, in many instances, surprising success. Wherever there are fats present, or fresh, delicate flavors or odors, these remain unchanged to a remarkable degree The writer sampled various kinds of nuts and fruits which had been in the cans for six months, or even longer, and in some instances would not have been able to testify that they were not fresh

Washing London Fog Out of the Atmosphere of a Motion Picture Studio

By Major Charles H. Bell

IT is a wise old adage that defines necessity as the mother of invention. And though they also say you can make a virtue out of necessity, it is more profitable to turn it to some useful account.

It was in the memorable October of last year, when London was visited by a period of fog which could have been of pleasurable interest only to the foreign sightseers, that production at a London cinema studio was held up for no less than a week, because climatic conditions made photography a matter of sheer impossibility. Work was going on on a big production, and the firm could not afford this enforced cessation of activities. It is true they had seen the possibility of such handicaps and had thought to cope with them with a certain degree of success by a system of condenser pipes. To an extent they managed by means of this system to clear the fog out of the studio last winter by practically sealing up the building 24 hours before starting work. But even then this necessary suspension of work entailed a considerable financial loss, as it meant days of enforced idleness for the entire production staff

This and like experiences brought the realization right home that the British motion picture industry could hope to carry on its work during the entire year only by grappling to some effect with this serious climatic process. Mr W. C. Riley, who for 20 years has been chief architect to the London County Council and who is responsible for the installation of the largest ventilation system in Great Britain, that in use on the London Underground Railway, was therefore called to their assistance After a series of consultations and preliminary experiments with certain devices, it was found that a practical installation could be built to effectually deal with the fog exigency—a plant that would remove all fog from the studio, maintain therein a given temperature and a certain percentage of humidity, and cool the studio to within 18 degrees of outside wet bulb temperature

The entire apparatus is automatically controlled and is so sensitive in response that the lighting of the arc lamps in no way influences the temperature of the studio, which without the apparatus would in this way be raised from 10 to 20 degrees. The plant is designed to circulate three and a half million cubic feet of washed pure atmosphere per hour This air is drawn from outside or recirculated from inside as required.

The air is admitted to the humidifier through a series of baffle plates, so arranged as completely to break up the incoming air and do away with pockets which can otherwise be formed The air then meets the first bank of sprays, consisting of 220 sprays fed by a two-inch water supply direct off the main During the winter months the temperature of this water is 35 degrees Fahrenheit A fogged atmosphere coming immediately in contact with this chilled water condenses and forms a saturated atmosphere

A further series of 180 sprays is fitted three feet behind the first bank These are maintained with a very high pressure of water supplied by a centrifugal pump driven by electric power, which water is circulated from a main washer tank at a temperature to maintain the correct dew point The air, after passing the second bank of sprays, comes against the eliminator plates, which are so designed as not to allow any particle of air to pass without meeting with a series of definite obstructions. The plates are washed with a separate supply of water at high pressure so that every particle of foreign substance is eliminated

After this procedure the air is brought into contact with a series of heating banks, heated by steam from low-pressure boilers in the basement of the buildings. This steam is controlled in the same way as the atmosphere so that only the correct percentage of steam is admitted to the banks, in order to give the temperature required and called for on the thermostatic boards on the studio stage

A main centrifugal fan distributes the air to the studio itself through a series of ducts with downcomers fixed at certain intervals along the walls of sufficient proportion to admit the requisite quantity of air with little or no pressure

The chief object of the distributing system is to maintain at all times a pressure slightly greater than the normal outside pressure and by this means to create a tendency in the atmosphere to leak outward from the studio, as against its normal tendency to penetrate *within*. By this means it will be seen that on foggy days there will be no necessity in future for the studio to be sealed up against the incursions of that arch-enemy of good photography From the tests already made, the plant has entirely justified expectations. Without such a perfected system of air-washing it would be without a doubt impossible to produce pictures in England on an American scale and maintain a large studio organization during the winter months.

With the use of the air-washer it has become a matter of course to operate in this way.

Humidifier for washing the atmosphere in a London motion-picture studio, showing main fresh-air trunk leading to the two stages

A Ship Without a Bottom

How the "F. D. Asche" Was Towed from Florida to New York with Only a Blanket of Compressed Air to Keep the Sea Out of Her Gaping Hull

By Robert G. Skerrett

The "Asche" in drydock. This view is taken from within the hull, looking out through the hole torn out of the ship's bottom

THE salvage of the oil tanker "F. D. Asche," a while back is another example of up-to-date wrecking methods applied skillfully under circumstances that would probably have staggered wreckers resorting to ordinary facilities. In fact, but for the course pursued the ship would probably have been deemed a total loss, for to have refloated her otherwise would have entailed disproportionately heavy outlays in labor, material and time. The "Asche" is a craft of 11,700 tons deadweight capacity, built less than four years ago and constructed upon what is known as the Isherwood system. The vessel is fitted with nine athwartship bulkheads and throughout the cargo space the compartments so formed are subdivided by a central fore-and-aft bulkhead. In other words each of the capacious oil tanks has a breadth of 30 feet, a length of 30 feet, and a depth reaching down the whole distance from the upper deck to the ship's bottom. These details are mentioned in order that it may be easy to grasp just what were the volumes of water entering the tanker when the plating of her underbody was ruptured.

The steamer left New York City in ballast the latter part of October bound to Texan ports to load with crude oil. Three days later, while feeling her way toward the Straits of Florida, her navigator received warning of a hurricane moving northward from the neighborhood of Yucatan Channel, and in the course of 18 hours, while cruising slowly and holding her position well off the Florida coast, the storm struck her in earnest. The weather was so thick that the tanker was headed to the eastward and for a number of hours was driven at full speed farther out to sea, but fearing that she might run across the main path of the tempest, the "Asche" was swung around and allowed to ride out the gale hove to. When the wind moderated sufficiently the "Asche" was pointed to the southward and west, and she was pushed cautiously forward while trying to pick up soundings on the coast of Florida. No observations had been made for a number of days, but dead reckoning indicated that the tanker was about three miles to the northward of Matanilla Reef and close to the Bahama Islands.

Nothing untoward happened until very early in the morning of the 27th of October, shortly after no bottom could be found at 85 fathoms, when the "Asche" suddenly grounded. To keep her from pounding and further damaging herself, her engines were stopped, all of her tanks flooded, and both of her anchors dropped to hold her where she hit. When daylight came the dry reef could be seen half a mile ahead with the seas breaking heavily upon the rocks. Later it was found that the ship lay just inside the outer line of Matanilla Reef and in water five fathoms deep. By that time the sea had forced itself into the fuel tanks and was putting out the fires under the boilers. S O S radio messages were broadcasted for assistance, and while other craft in the neighborhood proceeded to her relief they could do nothing to alter her predicament.

When the weather altered so as to permit of an examination, a brief survey disclosed that two-thirds of the steamer's bottom was injured if not torn away entirely. A subsequent survey showed the bottom plating of starboard tank No. 4 to be detached, and hanging only by its forward connections, so that persons standing on deck and looking through the open hatch could see right down into the sea. The pendant plating was caught in a crevice of the underlying ledge and thus served to tie the craft to the reef. The bulkhead at the forward end of this tank was crumpled up at its lower edge and fractured where bent. The question was how to deal with the situation and to get the "Asche" out of her dangerous position with all practicable dispatch. Haste was necessary lest the ship be overwhelmed by another storm and destroyed.

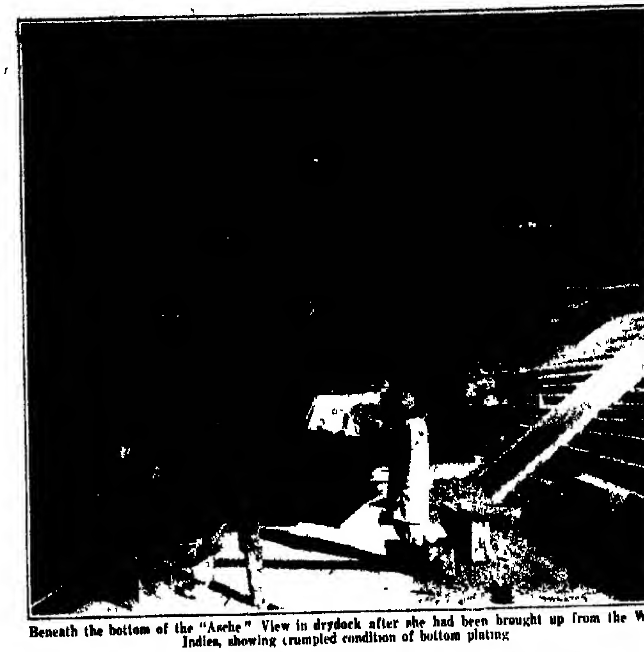
The salvage master, representing a well-known wrecking company, decided on the 30th of October that the tanker could best be handled by means of compressed air, and for that purpose air locks and compressors were dispatched to the scene of the wreck to help in refloating the craft. On the 9th of November the first attempt was made to release the ship, and the salvors were actually able to move her about six feet, but there she stopped because of the grip which the ledge had upon the hanging bottom plating of starboard tank No. 4. It was essential to break this hold before trying again to shift the tanker. At no inconsiderable hazard divers managed to attach a heavy purchase to the submerged steelwork, and the sturdy cable was then led to a powerful steam winch. In this way a pull of possibly 100 tons was exerted, and the anchoring bottom plating was drawn free and brought up approximately to its normal position and secured for the time being by lengths of strong chain.

Up to this point the forcing of compressed air into the flooded oil tanks sufficed to drive the water down and out generally to within four or five feet of the vessel's bottom, but this showed that there were many leaks in the battered skin, and it was necessary, as far as feasible, that these should be closed—working from the upper limits of the injuries downward so that the air could push out more and more water in order to increase the available buoyancy. This was effected by men sent into the compartments; and the most troublesome phase of their task was that involved in dealing with the fractures in the bulkhead at the forward end of tank No. 4, where the plating was doubled on itself somewhat like a fold of an accordion. The difficulty was finally overcome.

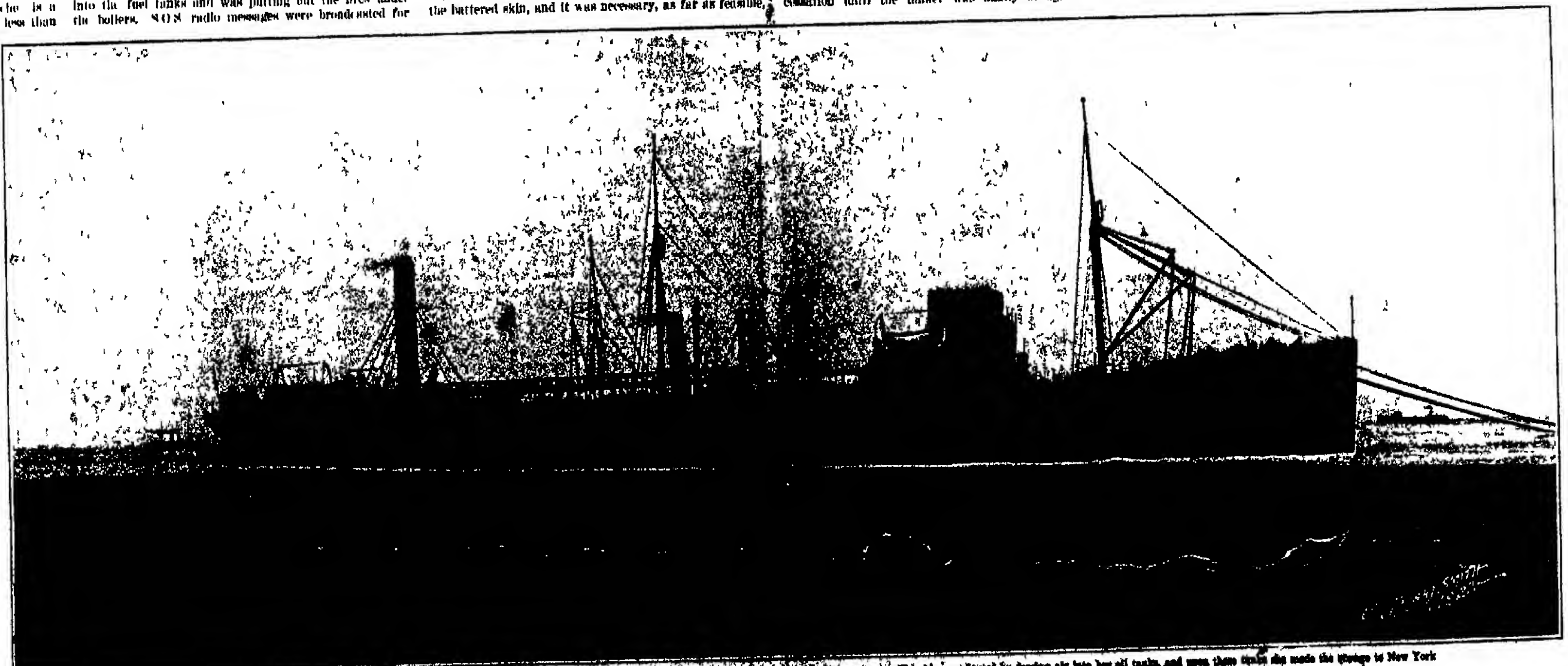
While starboard tank No. 3 was filled with compressed air—the men passing down into that compartment through an air-lock temporarily attached to a hatch on the upper deck—the salvors gradually plugged the ruptured bulkhead between tanks Nos. 3 and 4 by plastering the openings with successive layers of newspaper. The compressed air in compartment No. 3 was of a slightly greater pressure than that in the neighboring and more seriously damaged tank. This pressure served to hold the plastic sheets in place, and thus the water level was gradually lowered and the ship lightened correspondingly.

Compressed air was also fed to all of the flooded oil tanks by way of their regular pipe lines, and sufficient air for the whole salvage service was furnished by a group of powerful oil driven compressors. Early in the morning of the 11th of November, about a week after operations were started, the "Asche" was floated clear of the reef and towed to the shelter of a cay not far away, where the whole of her bottom could be inspected thoroughly by divers. As a result of their examination additional temporary repairs were made, and the steamer put in a condition to essay the journey northward. She was towed to New York and reached that port without further mishap on the 1st of December.

In effect, the "Asche" was virtually like a ship with no bottom, for her injured compartments were akin to so many inverted tumblers or diving bells—the intrusive sea being held at bay by the volume of compressed air with which each chamber was continually filled above the line of the still gaping wounds or breaks. This air was supplied by the salvage compressors that worked without cessation until the tanker was finally brought to rest upon the blocks of a New York dry dock. When the dock was unwatered it was possible to see just how grievously the coral reef had wounded the ship. The heavy plating of her bottom, from bow to stern, was successively indented until the steel skin formed a series of metal waves with ragged holes and open seams here and there. The worst damage, as we have said before, was at starboard tank No. 4, where besides the torn bottom the side plating was ripped and crushed to a height of eight feet above the keel. These visible evidences of her battle with the storm showed the manner in which the steamer was driven by the seas over the ledge and repeatedly dropped upon the underlying coral formation before coming to rest.



Beneath the bottom of the "Asche." View in drydock after she had been brought up from the West Indies, showing crumpled condition of bottom plating



The irregular white line [illegible] the oil tanker "Asche" [illegible] The ship was floated by forcing air into her oil tanks, and upon these [illegible] made the voyage to New York

Lost in Transit

SOME months ago we commented editorially upon the careless habits of the American shipper and told how an organized campaign by the Pennsylvania Railroad to educate the public and the transportation employees had resulted in a material decrease in the number of lost shipments and claims against the company. The American Railway Express Co. shows us a tabulation of similar results over a period of 3½ years.

The great evil with which the Express Company has to contend is packages found in terminals or on its lines with the marks missing or illegible. This particular variety of carelessness reached a high point in August, 1919, when no less than 33,000 such shipments were turned in to the "No Mark Bureaus" of the Company, of which it was necessary to maintain 20 with 213 employees. This volume of unidentifiable shipments was abnormal and is doubtless to be attributed to the very low caliber of the assistants in many shipping departments at this period. By March, 1919, the number of No Mark Pieces was down to 9000, which seems to have been about normal since it represents an average that was nicely maintained until October, 1920.

At about the latter date the company began an intensive campaign of education, trying to induce the shipper to be more careful and the receiving agents in the express depots to be more exacting in imposing standards of proper marking. The number of unmarked pieces turning up on the lines at once suffered a further drop, and by May, 1921, had fallen below 1500. It has remained in this neighborhood ever since, and the Express Company now maintains only nine bureaus to take care of these packages.

At the same time the number of claims of all sorts presented against the company has dropped from a high mark of 242,000 in January, 1919, to 70,000 in September, 1921. This means a fall from 14.5 claims per thousand shipments to 3.25 per thousand. The saving to the company in actual indemnities and in expense of tracing shipments is matched by the saving to the shipper and the consignee.

Tons of Silver from Waste Hypo

An Interesting By-Product of the Present-Day Motion-Picture Industry

By Charles Alma Byers

IT is a fact of universal knowledge, of course, that the motion picture industry is responsible for a product which sells to the public for millions of dollars in minted silver monthly. It is a fact known to comparatively few, however, that it also yields each month a by-product of bar or unminted silver worth thousands of dollars. The industry, in other words, not only is a "silver mine" figuratively speaking, but also is responsible for silver mining, of a kind, in the literal sense.

This by-product branch of the motion picture industry, be it known, owes its existence to the use of silver in the manufacture of film for motion picture purposes. The "coating" or emulsion, of the film, both negative and positive, contains, for instance, a considerable percentage of silver and in "developing" this film, which is done in a solution called hypo, much of this silver is naturally removed and thus made to comprise a deposit in the hypo bath. After a time this solution reaches the point where it is so heavily impregnated with the silver and other emulsion ingredients that it must be discarded, when it becomes so-called laboratory waste. The reclaiming of the silver from this waste is accomplished by various simple processes, and constitutes a business of quite exceptional interest and of not a little importance.

Precipitating silver from waste hypo, however, is not a new discovery or new practice. It has been done by photographers for something like fifty years, but naturally never before has it been done on anything like so large a scale as the great growth of the motion picture industry now makes possible. And in and about Los Angeles, California, where is largely centered the production end of the picture business, this side-line industry, that of reclaiming silver from film developer, has, as a matter of course, been brought to quite exceptional development. Some three or four firms, for instance, are exclusively engaged in the work, in that city alone and their product, it doubtless will be quite surprising to learn, amounts to on an average of something like a half ton of pure silver each month.

By way of bringing the possibilities of this by-product industry clearer to mind, it is estimated that the motion-picture studios in and around Los Angeles, when operating to normal capacity, use about 12,000,000 feet of film per month, and that in the developing of this film the use of approximately 30,000 gallons of hypo solution is required. The recoverable silver represented in the foregoing figures is estimated in two different ways. On the footage basis, it averages a little more than 800 ounces to each million feet of film which means a total per month of about 9600 ounces, or, by troy weight, 800 pounds. The quantity of recoverable silver to the gallon of waste hypo naturally varies very extensively for some laboratories permit their solution to become much richer in emulsion deposit than others. The range, in fact, is all the way from 20 ounce to over an ounce to the gallon but the average is put at about a third of an ounce. By this method of figuring it is seen that the normal average of recoverable silver from the waste is approximately 10,000 ounces per month. In addition to this, however, there is, as will subsequently be shown, a small quantity of silver that is recovered from the film in a somewhat different way.

Perhaps, before proceeding to an explanation of how this silver is reclaimed from the waste hypo, a brief description of how motion-picture film is made will prove generally interesting. Shorn of technical parlance, the film, it may be stated, is manufactured by making a pulp of cotton by a chemical process, into which pulp camphor is then rolled by powerful pressure. Raw or uncoated film is the product. A thin coating of glue is now applied to one side of the film, the result being called emulsion. Silver dissolved in acid, thus becoming known as silver salt, is next applied to this coated side of the film, with the result that a sort of chemical mirror, or sensitized surface, is created. Exposure through the camera lens now will cause the image or the picture to be registered and retained thereon, through the mere action of light. The silver salt touched by the light or light-rays, to put the matter more plainly, is chemically changed and thereby rendered insoluble in hypo, which, technically, is sodium hyposulphite. After the image is "fixed" or developed by organic chemicals, hypo is used to dissolve and remove the excess or unaffected silver, with the result that the parts of the film on which the light-rays of the image have registered are rendered in varying or relative degrees of opaqueness. Approximately a half of the original silver is, in the process, dissolved and hence left in the hypo bath.

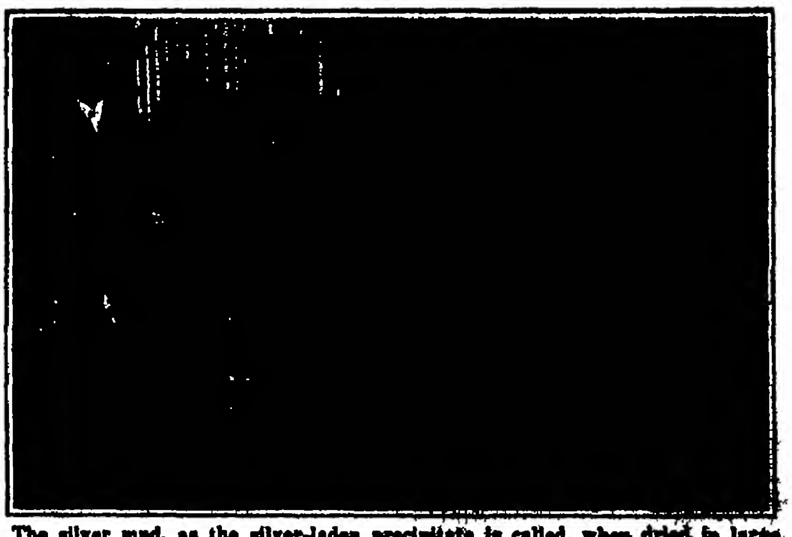
Tanks in which the waste hypo is stored and treated with a silver precipitant

To reclaim this waste silver is naturally no very difficult task. After being removed from the laboratory hypo tanks and transferred to other large tanks in the various so-called photo-metal refinery plants, the first act is to precipitate or otherwise mass the silver, which means that the solution must be so treated as to cause the foreign matter in the water, or its percentage of silver only, to either settle to the bottom or be congealed into a mass. This is accomplished in several different ways. One way is to direct through the solution a current of electricity, by means of which the silver ingredient will be made to form itself into a coating on a metal plate, as in silver plating. The more common method, however, is to treat the solution chemically, which may be done with some two or three more or less different preparations.

Sodium sulfide is perhaps the most generally used in the precipitation process. It will be used in the proportion of one pound to about twenty gallons of waste hypo solution, and approximately ten days must be allowed for it to complete the precipitation. Caustic soda, attended by the method of heating the mixture, is also quite commonly employed as a precipitant, and, when used with heat, will bring about the desired result in about one day. There are, of course, still other treatments, common to handling hydrated silver, that are employed occasionally, but which need no detailed mention here.

When once the silver, together with the other foreign matter, has been precipitated in this manner, the water is drawn off, and in the bottom of the tank will then be found a heavy, coal-black mud, commonly and quite appropriately referred to as "silver mud." This mud is subsequently removed and usually placed in large flat trays or pans over a slow fire, to dry. When thoroughly dry, it is broken up and, perhaps, stored in sacks until it is melted down. This silver mud, when dry, ordinarily contains about five ounces of silver to the pound mass. It is subsequently subjected to furnace heat, of about 2000° Fahrenheit, which results in the melting of the silver and the elimination therefrom of the waste matter. The silver is then molded into ingots, of the usual forty pounds each, and later disposed of to the United States Mint at San Francisco.

Another source of recoverable silver from motion-picture film has been referred to above. The film, or at least much of it, reaches the producing studio from the manufacturer without the sprocket punch-holes along the two edges which must be provided, in both negative and positive film, to equip it for reel manipulation. These holes are, of course, punched by machinery, and the tiny particles of film removed from the millions of footage in this operation accumulate most surprisingly. One of the Los Angeles companies engaged in this waste product business, for instance, reports that it has received as much as two tons of these punched-out particles in one month. The silver from this waste is recovered by the simple process of burning the particles, and then putting the ashes through the melting pot. Such ashes produce from five to six ounces of free silver to each pound, and a ton of the particles before burning is said to be worth from a hundred to one hundred and fifty dollars. More than this, even the wood of the tanks in which the hypo is used or stored becomes so impregnated in time with silver as to make the old tanks worth more than the cost of constructing new ones. And in recovering the silver from this wood the burning method is again resorted to.



The silver mud, as the silver-laden precipitate is called, when dried in large pans over a fire, assays five ounces silver to the pound

It may be added in conclusion that a half ton of pure silver—approximately the amount recovered each month as a by-product of the motion-picture industry in Los Angeles—is sufficient to coin about 13,960 United States silver dollars. The hypo "refiner," however does not receive a price for his product on this basis, for he must sell his silver at the market price—for so-called "foreign" silver. And a quite remarkable statement that may be made in this connection is that, until three or four years ago, all the silver-laden waste hypo produced by the motion-picture studios of Los Angeles went into the city sewers or was otherwise discarded, as being of not sufficient value to be worth the trouble of attempted recovery.

Liquid Air for the Laboratory

IN a recent publication, Scientific Papers of the Bureau of Standards, No. 418, entitled "The Production of Liquid Air on a Laboratory Scale," the design and construction of apparatus for the Hampson process is described. Brief descriptions of laboratory or special accessories are included.

This publication is now ready for distribution, and anyone interested may obtain a copy by addressing a request to this Bureau until the free stock is exhausted.

A Drill for the Tree-Dentist

TREE surgery has often been compared to dentistry; on its face, the expression "filling a tree's teeth" is descriptive of what the tree-doctor does when his arboreal charges develop rotten zones. This latest tool which has been put at his disposal makes the tree-doctor even more like the dentist in his procedure. We all know from sad experience the thoroughness with which the latter worthy excavates in preparation for his fillings, in order to be absolutely certain that he shall not put the latter in on top of any putrid matter. The tree-doctor has had to do his best to imitate this care with rather clumsy tools—chisel, saw, adz. But now there is provided for him a machine that is in every respect the counterpart of the electric drill of the dentist, and that attacks rotten wood in just the way that the dental drill attacks decayed tooth-tissue. Indeed, one can hardly resist picturing the tree as the giant possessor of a giant tooth, on which this giant drill is at work; or visualizing the operator as standing over his arboreal victim, instrument of torture in hand and cheerful smile on his face, the while he admonishes his patient to "Open wide."

This modification of the dental drill, for use in cutting rotten wood out of hollow trees, is so large that the head is assembled from circular-saw blades

The tree-drill is operated by a 32-volt, fan-cooled motor with pistol grip, trigger switch control, and a speed, without load, of 88 revolutions per minute. Its total weight with all connections is less than twenty pounds. The patent burr differs from that of the dental drill in that it is assembled, instead of being cut from a single piece of metal. It is made up of eleven tool-steel circular-saw blades, so set on the shaft that the teeth alternate. These blades are easily removable for sharpening. This device, invented by F. A. Bartlett, of Stamford, Conn., marks the successful solution of a problem with which tree experts have been struggling for a dozen years or more.

Auto-Bus Stability

AUTOMOBILE busses of large capacity are among the most unwieldy things known to the human race, so far as appearances go. It does not seem possible, looking at one of these huge carry-alls in motion, that it can be stable; one gains the impression that every turn will be a turn-over. One knows better, of course; there is nowhere in the world of motor busses a model that looks more utterly unbalanced than New York's Fifth Avenue busses, yet in fourteen years there have been but two overturns of these, both resulting from a driver's effort to make the bus stand on its tail and spin in order to avoid a collision with a car recklessly shot out of a side-street. Nevertheless, it does not seem possible, regardless of what reason may dictate, to convince the eye that these and others like them are really stable.

We present an interesting picture designed to overcome this instinct, if it be capable of overcoming. Loaded with 150-pound sandbags to represent its full complement of passengers, one of these busses was tilted to the angle shown without disaster. The tread of this bus is of such width that the inclinometer reading of 38 degrees, visible plainly over the cowl, reveals that the center of gravity is no more than 52 inches from the ground. If it were any higher than this, its projection upon the ground would fall outside the wheels at this angle, and the bus would capsize. It is claimed for this coach, the latest model put in service on Fifth Avenue, New York, that its center of gravity is lower than in any motor bus heretofore designed. The truck maker has a good start in his pursuit of steadiness, since the heavy frame and much of the heavy power-plant come naturally low in the assembly. But a performance like that illustrated deserves great credit, for all that.

Big auto-bus tilted sidewise at angle of 38 degrees, to demonstrate that its center of gravity is within 52 inches of the ground

Two views of the "Roma," Uncle Sam's airship recently acquired from Italy, on her trial flight

America's Latest Airship—"Roma"

THE largest aircraft ever flown in this country—the dirigible, "Roma," acquired by the United States from Italy—was subjected to its initial flight recently at Langley flying field, Virginia. The huge air-going machine has a length of 418 feet, carries 1,200,000 cubic feet of hydrogen gas, and travels at a rate of 80 miles an hour. With the replacement of its motors of Italian design with six 12-cylinder, 400-horsepower Liberty motors, the cruising radius of this dirigible will be enlarged to the extent of making possible a non-stop flight from the Atlantic to the Pacific Coast.

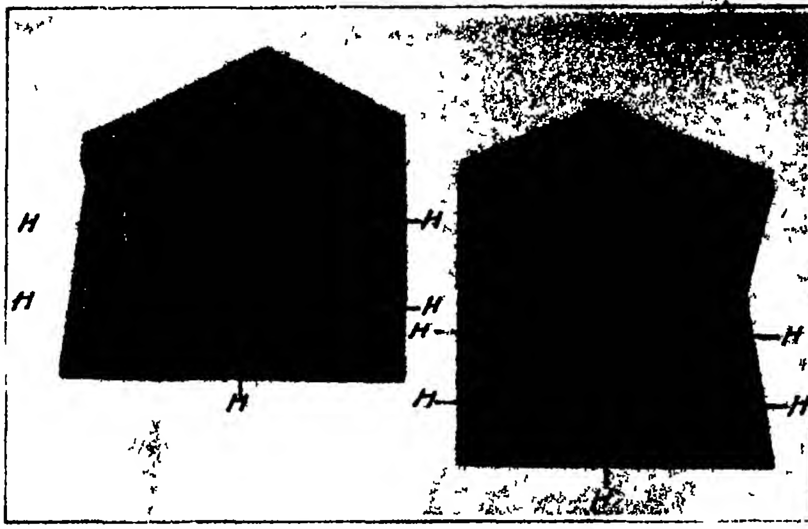
The "Roma" was built by the Italian government in Rome, Italy, and purchased by the United States government at the termination of the war. Its dimensions approximate those of the Zeppelins employed by Germany in raiding London and not quite so large as R-34, the dirigible detailed by England to cross the Atlantic. The size of the "Roma" is further emphasized by citation of the fact that there are only five hangars in America capable of accommodating this air-going structure. For example, the hangar at Wingfoot Lake Air Station, Akron, Ohio, is 400 feet long, a capacity which would leave the nose of the airship projecting outside of the door. The airship is 82 feet wide, 88.6 feet high, and is capable of transporting a useful burden of nineteen tons.

The maiden journey of the "Roma," after being refashioned and reassembled in the United States, was not without mishap, although of trivial consequence. After being in the air for slightly in excess of one hour the propeller blades on the left forward motor were shattered when a tiny aluminum door on the engine compartment fell into the propeller. Fragments from the damaged member ripped a big hole in the keel cover, and, also, perforated a series of small openings in the lower diaphragm of one of the gas compartments. Exercising a presence of mind commensurate with his responsibility, the technician on board the aircraft suspended the activity of the engine as a means of lessening a fire hazard. Gas was valved out of the damaged compartment to relieve the pressure while repairs were being made. Three persons were rendered temporarily unconscious by the hydrogen gas inhaled. The dirigible, however, continued to function in absence of the activity of the forward motors, and the flight, begun at 9:40 A. M., continued until 1:12 P. M. when the huge mechanism was again brought to earth.

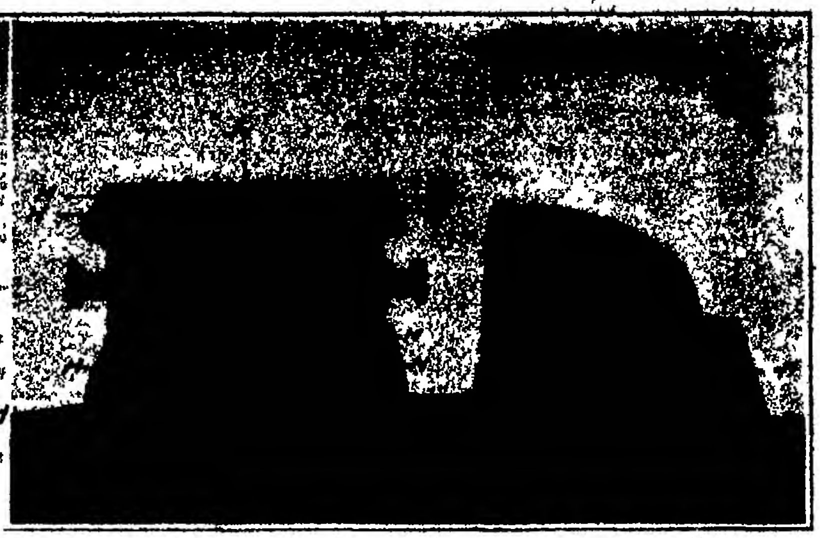
Radio telephony and radio-telegraphy communications were maintained with the "Roma" from the Langley flying field throughout the three hours of flight designed primarily for purposes of inspection. Amateur wireless operators followed the fortunes of the airship, and received information of the mishap to the propeller soon after its occurrence. The operating crew and passengers, all told, numbered 31 persons. When first taking to the air, the dirigible was free ballooned to a height of 400 feet, the gain in altitude being gradual as its pathway headed in direction of the Chesapeake Bay. The flight, for the most part, was made at an elevation of 200 meters. The Air Service of the United States Army contemplates a cross-country test flight in the near future, the plan being for the big dirigible to cross the Appalachians into Ohio.—*By S. R. Winters*

Building-Material Prices

THE Bureau of Standards has recently prepared a table giving prices on the more important building materials as of December 1st, 1921. This shows the prices in various cities of such commodities as brick, portland cement, lumber, lime, sand, stone, glass of all sorts, pipe, paints, varnishes and roofing materials.



1. The pattern plate and pattern, and the Cope container and pattern



2. The cope, and the drag mold. Note centering holes H for accurate assembling

Exactitude in Propeller Manufacture

The Substitution of Accurate Mechanical Methods for the Old Sweep and Pattern

IT is a strange anomaly that, in spite of the seventy years of development in steamship construction propellers have continued to be cast by what are broadly the same old foundry methods which were in use when the first steamship crossed the western ocean. It is only of late years that the Thacher process, which is used in making the propellers for our Navy, has furnished the art with the means of casting propellers which are so true to form and design that no machine-work is required upon them.

Progress in Propeller Design

The completely successful propeller must be designed to suit the conditions of the vessel it is intended to drive, it must be constructed absolutely true to the designed requirements, and it must be of a strong and durable non-corrosive metal. The advent of the Model Tank Basin has made it possible to obtain definite and dependable information as to the power required to drive a vessel of given size and shape at different speeds. The model usually of wood is constructed about 1/48 of the full size steamship, at least, that is the proportion recently adopted at the Washington Navy Yard model tank basin. As the model is towed, the resistance is automatically recorded and by the application of a certain formula to these data, it is possible to estimate with great accuracy the horsepower required to drive the full size ship.*

Propeller design formerly was based on rule-of-thumb methods, on comparisons between various ships or it was arrived at by repeated trials of different propellers until a suitable result was obtained. Rear Admiral Charles W Dyson U S N., devised a method consisting of a series of charts, curves and tables, by which all of the factors of propeller operation can be computed, the resulting design if the propeller be accurately constructed in accordance thereto, will give the desired efficient operation. However, because of faulty methods of propeller manufacture, poorly constructed propellers have often subjected the designer to unmerited criticism.

Materials in Propeller Casting

The materials generally used in propeller manufacture are cast iron and manganese bronze although steel, monel metal and other bronze compositions are also used. Cast iron propellers are less costly, but are more susceptible to corrosion. They are used chiefly in fresh water on river steamers tug boats, barges, and occasionally on ocean going tugs, tenders, tramps and freight steamships.

Manganese bronze however, is the usual material for the better class of freight, passenger and war vessels. It has a much higher tensile strength, has longer life by reason of its non-corrosive quality, and has proved to be the best material for the purpose. The tensile strength of good cast iron or semi steel varies from 25,000 pounds to 48,000 pounds per square inch with a very low per cent elongation, whereas manganese bronze has a minimum tensile strength of 65,000 pounds per square inch with an elongation of not less than 20 per cent in two inches.

Physical Requirements of Perfect Propeller

The physical characteristics of a perfect propeller are accuracy as to diameter pitch, blade area surface and uniformity of metal distribution. In diameter accuracy the tips of the blades must be equidistant from the propeller center. The pitch must be as designed, but it is of far greater importance that the pitch of each blade be uniformly identical with the pitch of each corresponding blade. This can be accomplished only when every given point in each blade lies in the same relative position to the axis as does the corresponding given point in every other blade.

The two most important elements in propeller manufacture are first the uniformity of pitch of each blade with the others, second the uniform distribution of metal in each blade. It is particularly in these two characteristics that propeller manufacture under the old methods has been found faulty.

Old Method of Propeller Casting

Previously, there were two general methods of propeller manufacture in use, known as sweep and pattern molding. The degree of success in these methods is limited to the skill of the individual molder, nevertheless, the most skilled effort cannot produce a propeller that is absolutely accurate in the essential particulars.

Fig 3 illustrates a mold for casting a 4-blade, solid propeller, which is here being made by the sweep method. In this method there is set up on the pouring floor a cast iron disk from the center of which projects vertically a round, steel spindle. Upon this spindle is placed a form, representing the hub of the propeller, and on a horizontal arm, or straight-edge, for mold sweeping. Four posts equidistant from the spindle, are set up on the outside of a circle that is slightly larger than the diameter of the propeller, and from these posts four inclines are arranged whose slope represents the pitch of the propeller. On these the spindle arm is moved to develop the mold pitch. A brick form is built up to represent the pitch or incline, and this form is covered with loam and swept to the true pitch with the spindle arm. This constitutes the bottom half of one blade mold. The cope or top half of the mold is constructed on the same general principles, and after the two halves for each blade have been thus formed, and baked in the oven, they are assembled and the pouring of the molten metal is performed.

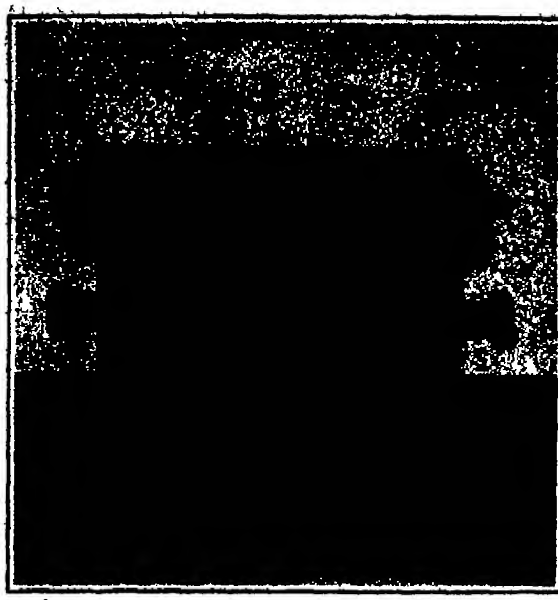
In the pattern method, the operations are broadly similar, with the difference that when a pattern is used it is constructed for one blade and hub set over the central vertical spindle, and the pitch incline and sweep arm are not required. It will be readily appreciated that this is not an exact method of molding, since each blade is separately constructed under different individual set-ups, and the errors of each blade are correspondingly individually different. Consequently, in Navy practice there is allowed on the surface of the propeller sufficient excess material of alloy for error correction by machining.

In exceptional cases a solid pattern is used. If it is of wood, it warps out of shape; and if of metal, it must be machine finished, which is costly; and even in this case; castings will vary according to the individual dexterity of the workman, and with the

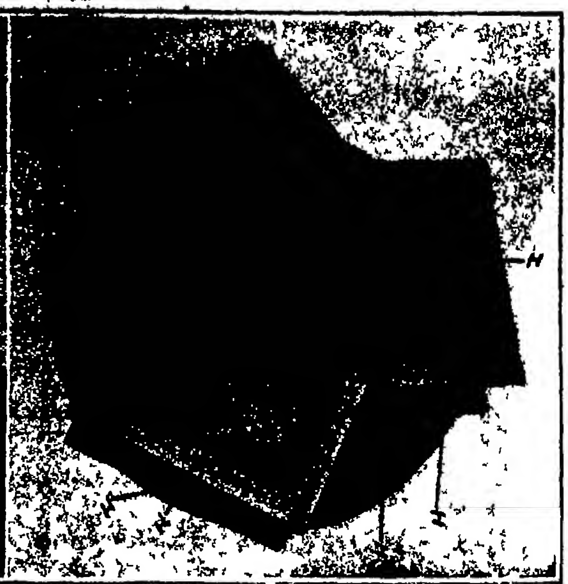
3. Preparing the mold for a 4-blade propeller by the sweeping process

material and foundry conditions which are constantly fluctuating. The construction of a 16-foot diameter, 4-blade solid propeller by the sweep process requires from 15 to 20 days with the highest class of skilled molding, and the resulting propeller is more or less imperfect in the essential requirements. These defects must be made good in the machine shop where, because of the irregular formation of the propeller, it is almost impossible to produce a finished product that is in perfect agreement with the designed requirements.

By way of illustration *of these facts we quote* the following four 3-bladed solid manganese bronze wheels were cast, the lightest weighing 14,392 pounds and the heaviest 15,807 pounds, the average being 14 747 pounds. The difference in weight was 1415 pounds, or nearly 10 per cent casting weight variation. After machining, these four propellers averaged 12,062 pounds, the lightest being 11,800 pounds and the heaviest 12,223 pounds, a difference of 443 pounds. In this instance the weight variation was reduced from nearly 10 per cent in the rough casting to about 3¾ per cent after machining. Yet the heaviest rough casting became the lightest finished casting and the lightest rough casting became the heaviest finished casting.



4. Cope and drag, after baking, closed and secured accurately by machined surfaces and locating pins H



5. Three drag molds for three-blade propeller, assembled in their proper positions on the surface plate

The New Method of Propeller Casting

Now the method of casting known as the Thacher process which is herewith illustrated is one in which the causes of casting irregularity and error have been mechanically eliminated, and by the following means. In a propeller mold the hub and blade form is accurately located with relation to a perfectly machine-finished surface plate containing accurately established drilled locating holes. Then the impression of these forms is mechanically transferred to sand molds contained within cast iron flasks having also accurately machined surfaces and identically similar locating holes. After the patterns are drawn the molds are sprayed with lead wash by air sprays to give a smooth finish to the surface of the mold.

The flasks molds are baked to present a hard surface that will not strain under casting pressure, and are then assembled on a large machine-finished surface plate, that contains a common center hole and a series of locating holes radially grouped around the center hole and corresponding identically with the locating holes in *the flasks and pattern surfaces. These groups of locat*ing holes are positioned at an angle of exactly 90 degrees *for* a 4-bladed propeller and 120 degrees *for* a 3-bladed propeller. Thus a pattern form established accurately with relation to a machined surface plate and locating holes, has been transferred mechanically to a mold form accurately established with relation to a machine-finished surface plate and identical locating holes; and as the blade as an entirety has been accurately transferred, every point in that form is positively established in correct position. The operation for each blade is identical, so it follows that the accuracy of each blade is identical. The work of preparing the surface plates, flasks, et cetera, is all within the range of standard machine shop practice, and is easily performed to an exact accuracy which will result in the foundry producing a propeller of equal accuracy.

TEST No 1

Description	No.	Material	Size	Weight Lbs	Average Lbs	Pounds Variation
Blades	1	Cast Iron	17′ 6″	4875		1
Blades	2	Cast Iron	17 6″	4875		1
Blades	3	Cast Iron	17′ 6″	4875	4876	1
Blades	4	Cast Iron	17 6″	4880		4
				Greatest Variation		5 pounds

TEST No 3

Description	No	Material	Size	Weight Lbs.	Average Lbs.	Pounds Variation
Blades	1	Bronze	18′ 6″	4345		2
Blades	2	Bronze	18′ 6″	4348	4347	1
Blades	3	Bronze	18 6″	4345		2
Blades	4	Bronze	18′ 6″	4,350		3
				Greatest Variation—5 pounds		

The installations of this type of propeller have shown remarkable efficiency in operation

Method	Rough Wt Lbs.	Finished Wt Lbs.	Molding Time Days	Per Cent of Actual to Designed Pitch
Old	*7703	6558	12½	Machined
Thacher	5308	4842	2½	99.9 as cast
Actual Saving	2395	1716	10	
Per Cent Saving	45.3	35.4	80	

* Includes metal allowance for planing blades

Table showing saving in time and material by the new process

Description of Equipment

A cast iron assembly plate, machine-finished over its surface is provided with locating holes transferred from the jig or template, and on this plate the finished mold is assembled for pouring. A template of cast iron, carefully machined, is used in putting the locating holes in the drag pattern plate, the cope container, drags, copes and assembly plate. The drag pattern plate on which is established a portion of the hub and the driving face of the propeller is an accurately machined plate with its holes drilled from the template. The cope container is a box like structure of metal with holes drilled from the same template. The drags and copes are also of cast iron and of box like construction heavily ribbed to prevent warping. The top and bottom surfaces are planed accurately and parallel and it is drilled for locating holes to correspond with those in the assembly plate, drag plate and cope container. The drag pattern and cope pattern are made of hard wood or of metal if preferred.

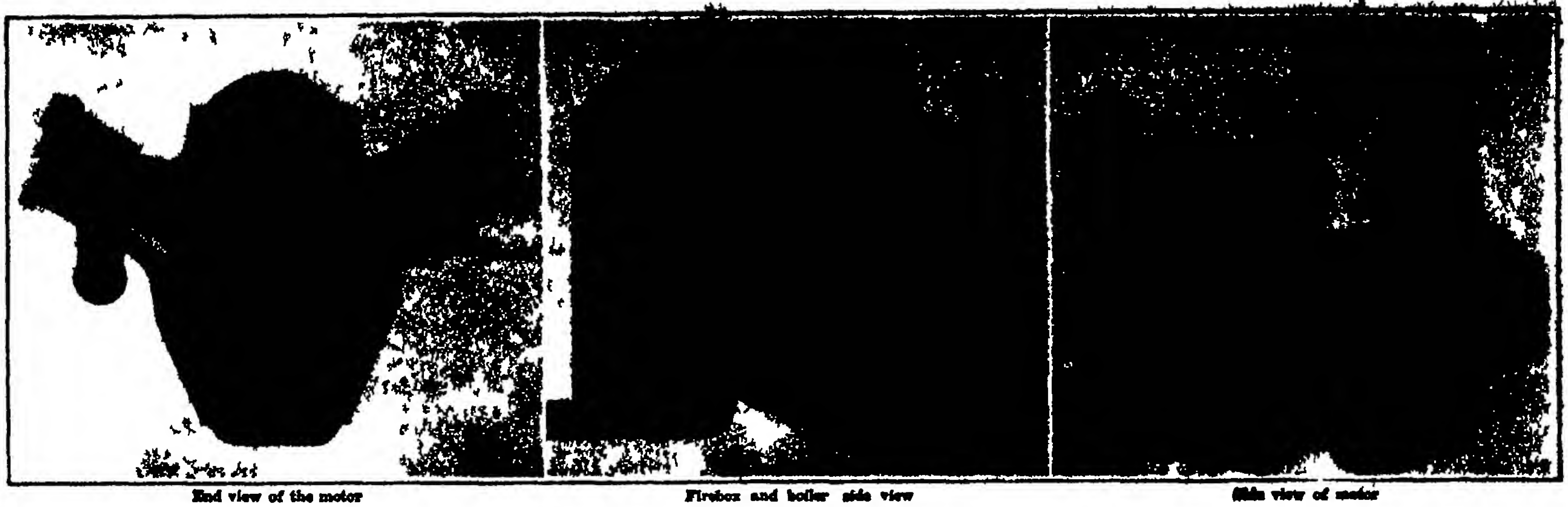
The Molding Operations

In the engraving in Fig 1 is shown the cast iron drag pattern plate to which is attached a pattern of wood which is set *to the exact pitch of the driving face of* the propeller. Over this is placed the drag *or metal molding box* (see Fig 2), the two being fastened together through bolt holes H. Sand is then rammed up over the pattern which is now inside the

(Continued on page 292)

6. The three drag-and-cope units assembled on surface plate, with pouring ring above, ready for casting

7. Propellers made by this process are so accurate that no machining is needed. A burnisher gives the needed finish



End view of the motor — Firebox and boiler side view — Side view of motor

Three sections showing important features of the new Coats steam car

A Steam Car That Is Different

Gas-Car Control and Gas-Car Finish with Steam-Car Smoothness

MORE than one steam car has been hailed as the new departure that would sound the knell of gasoline cars, but somehow or other many of these marvels have failed to materialize and nearly all of them have disappeared entirely from the markets they were supposed to capture. The principal reasons for this were that the faults of these early models were fundamental and their complexity was such that drivers gave them little care and much abuse. The result was of course lack of confidence on the part of the driving public.

But despite the absence of steam automobiles there has been great improvement in steam design and construction and the utilization of oils for fuel in the last fifteen years. Is the time ripe for a car embodying these improvements? The designers of the Coats car illustrated herewith feel that it is. This steamer presents an appearance so nearly the same as an up-to-date gasoline machine that it is practically impossible to tell the difference. Even upon close examination one might be unable to detect the fact that a gasoline engine was no part of its equipment. A foot brake and a clutch pedal occupy the usual positions and a gear lever exactly similar in appearance to those in use on gasoline cars is also placed as it might be on a gas car. The dash has a switch, there are electric headlights, the rear axle is practically the same as those in ordinary use, the radiator, which happens to be a condenser, is nevertheless to all intents and purposes a radiator, and only under the hood is there a change.

But here the change is manifest. A boiler occupies a position just behind the radiator and immediately behind that, under the driver's feet, is the engine and gear box. Only in these units is the car different.

To start the car the driver does as he does in a gasoline machine. He turns a switch—starting a small electric motor which drives a fan and a pump. The fan forces air through the firebox and when the pump has placed the fuel under 45 pounds pressure the automatic atomizing jet at the top of the firebox opens and sprays kerosene (which here gives better results than gasoline and is far cheaper) into this firebox in quantities exactly suited to the amount of air that enters. The kerosene is sprayed past a spark plug which automatically ignites it, making the old and objectionable pilot light a thing of the past. The fire once started enough steam to run on is generated almost at once.

A throttle lever placed just below the wheel controls the entire forward movement of the car. There are speeds—two of them forward and one reverse—but there is no clutch and the car starts just as readily on high as on low. Very little use will ever be found for low except in emergency where excessive power is required.

To reverse it is necessary as with the usual car to shift gears, for this steamer is not equipped with a reversing engine. The reason for this is that most people are familiar with the usual gear shift reverse while few understand the principle whereby a simple shift of cams reverses the steam engine. Being without a clutch however makes it necessary for the driver to close the throttle before backing up.

There is a clutch pedal however but that is used only when more power or speed is needed. Then this pedal is depressed allowing steam to enter the cylinders for the full length of the stroke. When the engine does not require this extra power the inlet cuts off the incoming steam when the stroke is five-eighths completed and the expanding steam completes the stroke.

The engine is V shaped and has three cylinders with two on one side and one on the other. Had they been placed radially one cylinder at the bottom would have caused trouble by reducing clearance and would have been a catch-all for water that might collect from condensation, endangering the cylinder itself which might have been subjected to fracture because of the water being compressed by the piston. As the cylinders are placed there is no possibility of this and the crankshaft is so swung that an impulse is given it every 120 degrees while the impulses themselves are felt through very nearly 180 degrees, thus overlapping for nearly 60 degrees and adding to the usual smoothness of the steam engine the overlapping power of the multi-cylindered gasoline engine.

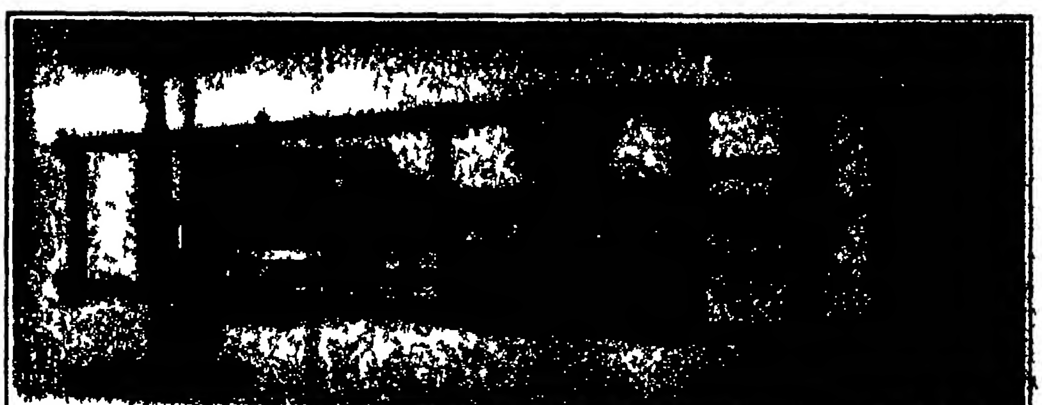
The engine itself is light, small and powerful. Tested as a gasoline engine would be tested it produces over 50 horsepower and yet it swings no flywheel and carries but twenty-odd moving parts. There are no spark plugs in the cylinders, no carbon to foul the oil and hurry the wear of the cylinder walls and pistons. The pistons themselves are fitted with three rings each, which offers an exceptional factor of safety.

The inlet and exhaust valves are similar to those in use in most gasoline cars. The incoming steam enters when a poppet valve is actuated by a camshaft, and this inlet valve closes when the piston has moved five-eighths of the way down the cylinder except when the foot pedal is depressed, when it allows steam to enter for the entire stroke. At the bottom of the stroke a port similar to those in use in some two-cycle engines is uncovered, and the steam escapes until that which remains in the cylinder is under ordinary atmospheric pressure. But instead of the piston's working against this pressure on its return stroke, a relief valve opens and the returning piston entirely exhausts the steam. At the top of the stroke the relief valve closes and the inlet opens, repeating the cycle.

The escaping steam passes into the radiator-like condenser and when condensed returns to the water tank as water retaining some of its heat and consequently subject to quick use again. The car carries 25 gallons of water and needs to be filled only after several hundred miles.

It is only natural that the boiler of a steam car should attract attention. The Coats boiler is unique in several of its features. It is built of 20 drawn steel water tubes each 17½ feet long. These tubes are very easily interchangeable and can be removed and replaced merely by releasing two bolts at each end. The headers are built of pressed steel and are one-fourth of an inch thick. The hot gases pass down the firebox and are directed upward through the forward half of the boiler to the superheater above, and after passing the superheater and the steam chest, which are located on top of the boiler, they pass down on the other side of a baffle-plate that runs vertically and laterally between curves in the water pipes. The used gases pass through a long pipe the length of the car and are finally lost in much the same way as is the exhaust of a gasoline car. In the whole car there is not a single appliance that is subject to adjustment. There is nothing that is not permanently set and consequently there is no temptation on the part of the amateur driver to "monkey" with his car. For instance the valve that sprays the fuel can by no possibility be changed. There is no adjustment to it. The safety valve on the boiler is set and sealed. It cannot be tampered with. The turn of a switch starts the car and when the steam pressure reaches 600 pounds the fuel is automatically turned off, and when the pressure has been reduced to 550 pounds the fuel is automatically turned on and is ignited, not by a pilot light but by a spark plug.

In cold weather the car stands no more danger of freezing than a gasoline car—less in fact, for the heat stored in the boiler will for a considerable time preclude the possibility of freezing, and if the car is to be used in very cold weather, where it will be required to stand for long periods at low temperatures, anti-freeze mixtures can be used in the water without any danger, or the car can be drained with no more trouble than a gasoline car.



Chassis of the new steam car, showing location of the various units

Testing Circulation in Kilns

THE best method of testing the circulation in a dry kiln is to watch smoke travel through the piles of lumber. A device for producing a fireless chemical smoke is used for this testing by the Forest Products Laboratory. The device is easily made by using some short, thin boards; two small, wide-mouthed bottles, some three-sixteenths-inch rubber tubing, and a six inch length of one-eighth inch glass tubing. The chemicals used are concentrated ammonium hydroxide and hydrochloric acid.

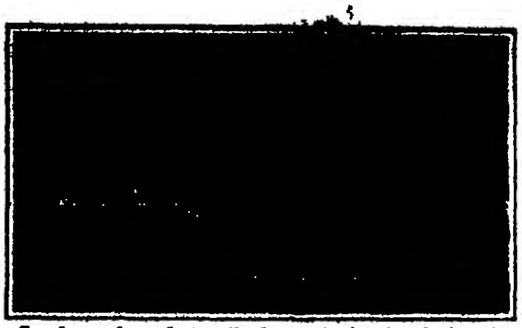
In using the apparatus a small amount of each chemical is poured into the bottles. By blowing through the rubber tubing a dense white smoke issues from the bottle containing ammonia. The device may be carried into a kiln without danger of fire and the smoke will follow air currents without any tendency of its own to rise or fall.

Evaporating Apparatus That Dispenses with Fuel

IN a great many industries, such as the manufacture of salt, sugar, caustic soda and potash, an essential feature of the operation is the evaporation of the excess water from the solutions of the crystals. To evaporate 100 kilograms of water at 100 degrees Centigrade, 537 calories of heat must be furnished, which requires the burning of not less than 220 to 250 grams of good quality coal. The heavy rise in the cost of coal during the last seven years has led to many attempts at the finding of a less costly method of evaporation. One of the most interesting of these is a revival of a process suggested by a French inventor named Pelletan, nearly a hundred years ago (1833). The principle upon which this method is based is shown in our drawing.

The solution to be concentrated is placed in a container, A, in which is immersed a coil of pipe B. The vapor above A is drawn in by a compressor which recompresses it within B. Here it is condensed and thus restores its latent evaporation heat to the solution A. It is evident that the same heat required for the evaporation is used over and over for an indefinite number of times. The water discharged from B is pure distilled water, so that the process can be made to serve a double purpose—concentration and distillation.

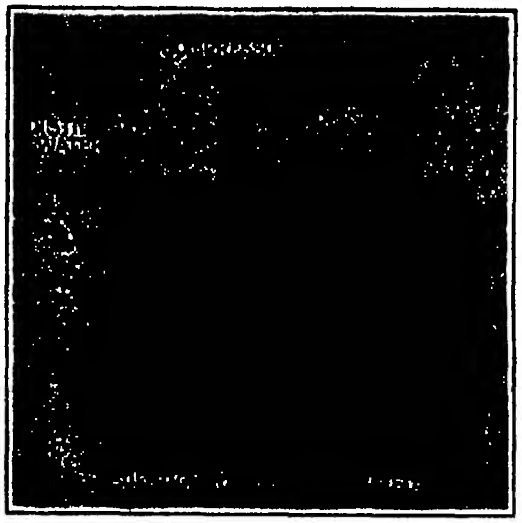
It is obvious that the liquid which is condensed in B must have a higher temperature than that of the solution A, so that there may be an exchange of heat between B and A, but the difference between them need not be very great provided there is not much loss of heat, the degree of compression provided by the compressor must be calculated with this in view. It must also be taken into account that when a solution is concentrated the vapor tension of the solvent is lowered—in other words when the same pressure is maintained at the surface of the solution the temperature of the latter will rise when the concentration is increased. Under these conditions the vapor or steam above the solution is superheated and the compression



Smoke-maker that tells how air is circulating in drying apparatus and the like

which it undergoes increases the degree of the superheating, so that to secure condensation one must inject water into the compressor. There are practically no calories lost since the loss which occurs in the compressor is regained in the steam.

The sole expense is that of the mechanical energy required to operate the compressor. This may be obtained from an electric motor which may be run by water power. The chief difficulty with this method

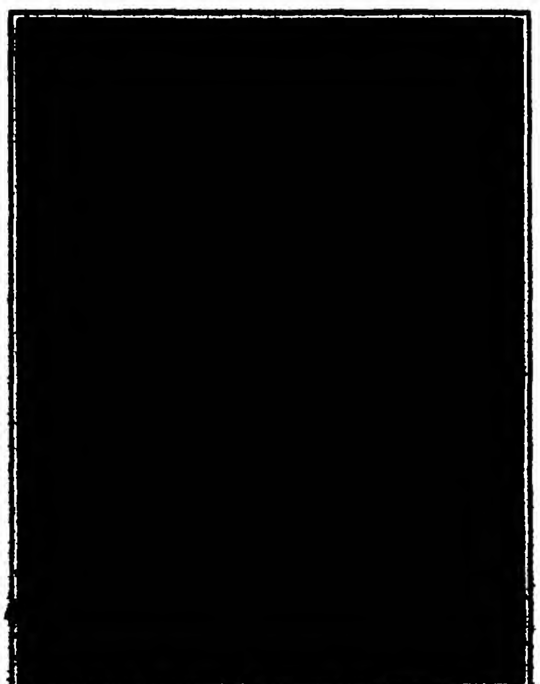


The fuelless evaporator

has hitherto been with the compressor since both those which have an alternating movement and those known as ejectors in which the vapor extracted from the solution is drawn in and compressed by a jet of live steam, are unsuited. The use of a rotary compressor appears to be more promising. In fact, important applications were made in Germany during the war especially for the concentration of sea salt.

Aside from the economy of fuel the advocates of the Pelletan process claim another advantage—that of the facility with which it operates at a low pressure and consequently at a low temperature which of course makes it valuable for treating substances which undergo alteration at high temperatures.

The rotary compressor now in use, however, is not practically efficient at less than 50 to 100 horsepower. Hence it can operate only upon gases at a comparatively high pressure. For this reason the Pelletan evaporating process is limited at present on the one hand to large plants and on the other to evaporation not requiring a high degree of vacuum. Its application will undoubtedly be widely extended as soon as a rotary compressor having a high degree of speed and capable of extracting gases at low pressures is constructed. Even now it results in great saving of fuel where it can be suitably employed.



Automatic traffic regulator that gives warning when about to shift its indications

Automatic Traffic Regulation

AUTOMATIC traffic regulation is more and more the order of the day. Milwaukee is the latest city in the field with a device to effect this. The noteworthy feature of the installation which we illustrate is the excellent provision which it makes for changing the direction of traffic.

The four open windows which our photograph shows are duplicated on the other sides of the post. The upper compartments show the signal "Go" in green letters on the east and west, and "Stop" in red at north and south. The lower compartments reverse this arrangement. Reversal from the one set of signals to the other is done automatically, by means of a clock control. According to the relative importance of the streets at whose intersection the signal stands, the upper or the lower set of signals may be given more time than the opposing ones, by proper setting of the controls.

The appealing feature of this signal, however, is the "Traffic Change" globe that surmounts the whole. This is lit for a few seconds only, just before the shift in the signals. It gives warning of what is coming and affords an opportunity for all vehicles on the street that is about to be blockaded to clear the crossing. This globe is 16 inches in diameter and when lit can be seen for a mile.

During the hours of darkness the four base lights are also lit so that there can be no excuse for any driver's crashing the concrete base of the signal. The whole installation has made a decided hit with the Milwaukee public, pedestrians and motorists alike, and the use of the device will be extended. Since it was installed on August 12th at one of Milwaukee's test corners there has not been a single accident here. The signal is the invention of Hugo A. Kleinsteuber of Milwaukee's police and fire alarm system. It goes without saying that at times of parade, fire, extra heavy one-way traffic, etc., the motors can be thrown out of gear and the signal operated by hand.

Helium

THE experimental helium plant at Petrolia, Texas, conducted under the authority of the Army and Navy Helium Board, was in operation during the year at various times and helium was produced for short periods. A study of the practicability of storing this rare and non-inflammable gas in mine workings was made at the Bureau of Mines experimental coal mine at Bruceton, Pa. At the cryogenic or low temperature laboratory in Washington, D. C., liquid air in quantity is now being produced. The primary object of this laboratory is to investigate gases and liquids at low temperatures with special reference to the separation of helium from natural gas. Field investigations of possible supplies of helium in natural gas were completed during the year, every known gas field in the United States having been tested. Results were markedly successful, as they have shown that this country contains the largest supply of helium-bearing natural gas in the world.

A Cooling Fan That Advertises

AN Arizona shop that wishes to keep its patrons cool and at the same time justify the expense somewhat by advertising benefit ran two series of fans from the front to the rear of the store. Each fan surface is a muslin sign on a frame suspended from the ceiling. A jointed rod runs the entire length of each series with a pivot connection with each fan rod. The long rod is pivoted to one side of a drive wheel in the rear so that as the wheel revolves it alternately pushes the fans forward and draws them back. The power is secured from the regular power shafts used by the concern, and being of a very low order it costs little or nothing to produce.

These advertising signs are fans, too; they are rocked back and forth in their bearings by a shaft

Scientific Road Legislation

How the Federal Highways Act Will Take the Hit-Or-Miss Characteristic Out of America's Road System

By C. H. Claudy

ONE of the natural consequences of national growth and national development is that some things that were once regarded as matters of purely local concern, in which the Federal Government should under no circumstances meddle, are now found to be of more than local consequence A hundred years ago it was not mere local pride and prejudice that made road-making a local affair it was the very nature of the case that made it so Today, by the same token, it is not Federal interference or the desire of one section of the country to run things for another section that leads the Government at Washington to take a deep interest in roads throughout the nation and to formulate a program for their proper construction and maintenance it is the fact that, in 1921, roads are a matter of national concern that lead to this action What the Federal Government is to do for America's roads, and why, and what should grow from it, under the Federal Highways Act which was passed in November, and is just coming into good effect as this issue reaches our readers—this is Mr Claudy's theme here—THE EDITOR

THE United States has never until now possessed a truly national road policy The automobile was developed, grew up and overran our two million miles of highways, with highway legislation lagging far behind its development Sporadic attempts to arrive at a consistent scheme of a country-wide road system were made cases in point being the Bureau of Public Roads with its experimental laboratories, and the recent Federal Aid Road Bills, encouraging the several states to build roads, by paying part of the cost from the national treasury But not until the passage, in November, of the Federal Highway Act could we be said to have formulated a real road policy This bill marks an epoch in our road construction because, first, it outlines the beginnings of a national highways system and second, because it establishes new principles in the legal aspect of governmental road construction

Hitherto Federal aid has been distributed among the states according to a formula taking into consideration existing road mileage, population and amount of rural free delivery routes Beyond this the Federal government did not go states were permitted to spend their Federal aid upon any roads in the state they desired which might meet with the approval of the Secretary of Agriculture

Now all Federal aid must be spent upon not exceeding 7 per cent of such state road mileage, and three-sevenths of this mileage must be "primary" or "interstate" highways Moreover, the designation of these interstate highways is left not entirely to the State Road Commission The road plan of this Commission for highways to receive Federal aid is subject to review and approval by the Secretary of Agriculture (which means, in effect, the Bureau of Public Roads), so that the "interstate" highways of adjoining states may be made to join. In other words, Uncle Sam is going to give Federal aid to states, as before, but now is going to be sure that three-sevenths of the roads so aided shall form a national highways system The remaining four-sevenths of a state's road mileage which may receive Federal aid, must "connect or correlate" with the three-sevenths.

This is the real beginning of national highways. The power of initiation of a Federal-aided road building program is still with the state but the power of veto is with the Secretary of Agriculture, and neither state nor Secretary may permit less than three-sevenths of the designated mileage to receive Federal aid

The most vitally important provision of the Federal Highway Act is that for maintenance Curiously enough, we, who pride ourselves upon being the most practical people in the world, especially in matters of engineering, have never fully recognized the undoubted fact that roads wear out just as do any other man made product Our roads have been built, often, as well as roads can be built Our engineers need take a seat back of no corps in the world when it comes to layout, drainage, curves, grades, materials, foundations, subsoil packing construction, and finish But we have too often gone upon the hypothesis that a road once built was like a monument, enduring for all time Hence an intolerable waste of public money has resulted in the often complete destruction of fine roads, due to parsimony in maintenance funds or the complete absence of any systematic maintenance plan

Nothing like that under the new Federal Highway Act States accepting Federal aid to build roads must maintain the roads so built and provide in advance the necessary funds If they do not, the Secretary of Agriculture will notify them If, after notice they still do not maintain their Federal aid roads, the United States will come into such states and do it for the state and thereafter those states get no more public funds for road improvement until those maintenance bills are paid in full

As the time to begin to maintain a road is the day when it is opened for traffic, no state can accept any Federal aid for any road building without showing the funds in hand for maintenance.

Here is the second legal moving spring toward national highways, as completely made, owned, improved and maintained by the nation In course of time, as a larger and larger mileage in each state gets improved and demands maintenance, a larger and larger proportion of state funds will be so utilized. The "saturation point" will come sometime, when all the state's road funds are absorbed in maintenance. At that time, when a state finds itself estopped from further participation in Federal aid because all its available funds are used in maintaining already built Federal-aid roads, it is likely to become an enthusiastic convert to the doctrine that the Federal government should maintain all interstate roads. And when the United States undertakes a policy of road maintenance it is obvious that it will also undertake a policy of national road-building.

Upon these two great provisions of the new act "hung all the law and the profits" (to paraphrase) of road building in its new legal aspects.

There is no loophole left for political graft within the state. In times gone by jobs upon the State Road Commission were not infrequently looked upon as proper rewards for party work, without any regard to the engineering fitness of the appointee to the work to be done That is now impossible. The act specifies only such "durable types" of surface and materials as will "adequately meet both the existing and probable future traffic needs" and also lays down the dictum that the word "maintenance" means "the constant making of needed repairs to preserve a smooth-surface highway"

From time to time there have been examples of well-conducted propaganda campaigns in this country looking toward the adoption by the United States of some "standard type of road Naturally the people who make brick would like to see brick made the standard The concrete people would find much profit could Uncle Sam be led to demand concrete for all road construction, and the tar-and-oil product people would like to see macadam roads treated with their products made a standard

Their hopes are finally and forever dashed in this bill, which is as it should be In a country of such variety as this, where both the road-need and the road material vary largely, the specification of any one type as a standard would be a "pork barrel" of unprecedented proportions Hence the provision of this act is of great importance that the Secretary of Agriculture "shall approve the type and width of construction and reconstruction and the character of improvement, repair and maintenance in each case, consideration being given to the type and character which shall best be suited for each locality and to the probable character and extent of future traffic."

Unfortunately, our legislators either lack vision or have too much confidence in the ability of any one man, no matter how honest, to dare criticism. For while the act specifies a wearing surface of not less than 18 feet (save in some special cases) the important matter of "right of way" is dismissed with the single proviso that it be of "ample width." What, O Solons, is "ample width?"

Broadway and Fifth Avenue were both of "ample width" when laid out. Are they now? At what cost could Broadway be widened? Had Broadway been widened a hundred years ago it would have cost, perhaps, less than would now be needed to widen one block of its length.

The country road of today is the intercity boulevard of tomorrow. Twenty years ago an 18-foot road between New York and Philadelphia was plenty big enough. Is it so today?

"Ample width" means anything, or nothing. Doubtless a man building an 18-foot road today thinks 30 or 40 feet of right of way "ample." But what of tomorrow, a hundred, two hundred, three hundred years hence? Will a hundred, two hundred, even three hundred feet be then of "ample width?" Does it take a Jules Verne to imagine a 300-foot boulevard between great cities, its center devoted to high-speed traffic, its adjoining sections to normal-speed traffic, its edges to truck traffic? Why wait until property is prohibitive in price to secure a real "ample width?"

However, no law is ever perfect, and this one doesn't pretend to be. It is a great step in advance. It turns over to road making an enormous amount of surplus War Department machinery—tractors and road machines, steam shovels and concrete mixers, etc. And this is of vital importance, for states too poor, or too backward, or too ignorant to appreciate what modern machinery can do, and which therefore will not purchase, will take as a gift and use the "new-fangled" road making methods. And once the object lesson has been seen, exit the old way of making roads, by shovel-in hand and inexpert labor

The new law is specific on many other points. One of special interest to travelers is the provision that all Federal aid highways shall be toll-free, and that "bridges" are considered as included in the term "highway" So there must be an end to toll bridges if they are on Federal aid highways. But it would be impossible in an article of this length to analyze the bill in its every section. Suffice it that this is constructive legislation that it specifies an interstate system and demands maintenance, so that the hundred and fifty millions of dollars which may be spent by states and nation together in the next eight months will go for something which really connects part with part, and for roads which once built, can not thereafter be neglected, to the detriment of traffic and the wasting of their cost.

Why Not Stainless Steel Cutlery?

AN American lately returned from abroad, having visited South America, Australia, South Africa and Great Britain, was impressed with the stain-resisting steel which is now very rapidly replacing the usual form of steel cutlery knife He made inquiries, on coming home, whether it was possible to purchase similar knives here, and he found that the knives available were indifferently finished and it was difficult to get any of this new steel

On further pressing for information he found that the best of this stain resisting steel is the result of an invention on American soil He made it his business to call on one of the large cutlery manufacturers to find out first-hand why it was not possible for him readily to buy never-staining cutlery Stripped of much verbiage and extraneous matter, the explanation offered was that the American consumer had already substituted the familiar plated knife, with its utter inability to cut anything tougher than hot butter, for the old-fashioned stain-inviting steel knife, and that the American housewife had not become educated to the advantages of the stainless steel and to its beauty.

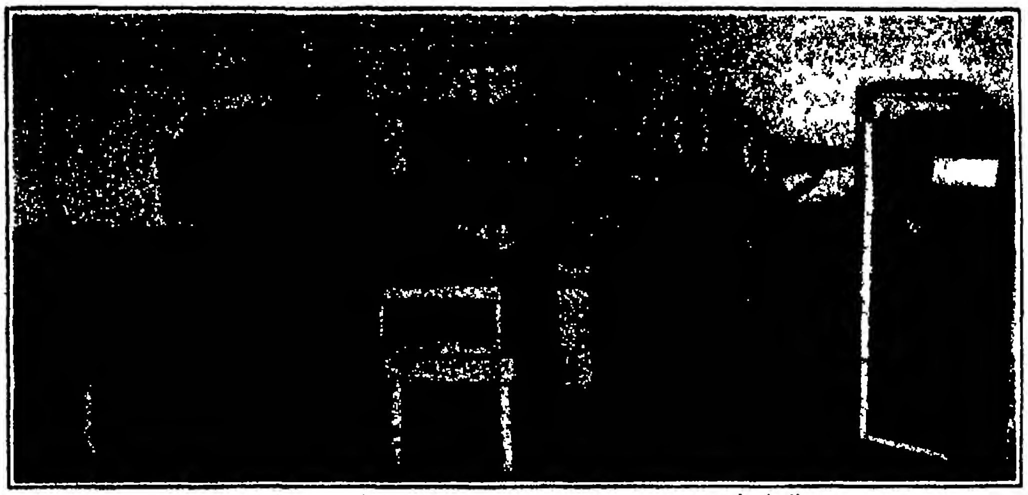
Under cross-examination, however, this manufacturer was asked how long the average stainless-steel knife-blade ought to last with the amount of sharpening it is likely to get in ordinary use. Reluctantly and indefinitely he put the period at about twenty years. In response to the definite question, he then freely admitted that within a very short time his plant alone could turn out all the knives that the American public were likely to buy providing there were no replacements in a period of, say, twenty years. It appears, therefore, that the only way the American consuming public will get stainless steel knives is by insisting upon having them. As for their advantages, even the maker of the other kinds of knives will hardly enter much rebuttal, unless it be on the ground of cost.

The Raw Materials for Artificial Daylight

Some of the Little-Known Processes and Machines Used in Making Incandescent Lamps

By Harry A. Mount

A BRIEF investigation on the part of the writer served to establish the fact that a visit to one of the great incandescent lamp factories near New York, for the purpose of describing to readers of this journal the intricate process of manufacture—or for any other purpose—would be impossible. Aside from the German dye industry, there is perhaps no other which guards its secrets so closely as does the incandescent lamp industry. Notwithstanding that the electric light is one of the outstanding developments of an age of mechanical and electrical marvels, few persons know anything of the methods of manufacture



General view of the equipment for making electric-light bulbs

An official of one of the great factories of the kind explained that while the largest plants operate under license from a parent concern, which maintains great central research laboratories, each of the individual plants maintains a research staff of its own, engaged especially in the design of automatic machinery for lamp manufacture Thus, the research development on incandescent lamps is available to all of these associated manufacturers, but the machinery is not common property, and each factory has secrets which it guards even from its associates. And especially are these secrets guarded from the ears and eyes of some fifteen independent manufacturers who operate without license But through the courtesy of Mr Charles Eisler, of Newark, N J, one of the foremost designers of lamp-making machinery, we are at last enabled to present herewith what is believed to be the first popular exposition of modern electric lamp making.

It is probably because the public has not been allowed to watch the evolution of lamp making from the days of tedious hand work, that the machinery which makes modern lamps seems little short of marvelous. The machines seem the more wonderful to the eye of the layman because many of them handle glass, and the idea of modeling glass parts with minute precision by automatic machinery is in itself something of a novelty The usually well-informed man would probably say that incandescent lamps were made by skilled hand workers, trained to the tedious processes involved. As a matter of fact, they are touched by human hands only in being transferred from machine to machine. Marvelously contrived machinery now does the work that once was done by skilled fingers.

Have you ever examined an electric light bulb from the viewpoint of a manufacturer? It presents a puzzling manufacturing problem. In making an ordinary vacuum type lamp—the easiest of all—there are no less than seventeen distinct manufacturing operations. The gas-filled lamps require a number of additional processes.

The first step is the drawing of the tungsten wire for the filament, and in all industry there is not a more delicate manufacturing process. The tungsten comes to the plant in the form of a powder, and by means of great hydraulic presses exerting tremendous pressure, this powder is molded into slugs ¼ of an inch square and from 12 to 16 inches long.

The slug must be most carefully handled in removing it from the press and placing it in a "sintering furnace" where the two ends are connected to a powerful electric circuit Current is passed through the tungsten slug until it is heated to incandescence This causes a welding together of the particles which compose the slug after which it is not so liable to break The metal is still too brittle, however, to be drawn into wire in the ordinary manner and swaging is resorted to The swaging machine contains a multiplicity of small hammers which operate very rapidly and beat the slug down to a smaller diameter By a number of swaging operations the slug is finally reduced to a wire about 1/32 of an inch in diameter Drawing is then begun The wire is drawn through a succession of diamond dies, each die reducing the diameter of the wire about 10 per cent The dies consist of steel blocks in which a diamond is set A hole is drilled through the diamond, through which the wire is drawn mechanically When finally the wire is drawn to the fineness of a hair its original length of sixteen inches has increased to thousands of feet The last stages of the drawing must be done in very fine steps for the wire must be perfectly drawn and of a uniform diameter to insure a uniform quality of filament If the wire is to be used in the ordinary vacuum type of lamp it is then taken to a zig zag machine which heats the wire electrically, bends it in the zig zag shape it must have in the lamp, and winds it in this shape on spools. The crucial step in this operation—the bending—takes place in a nitrogen filled chamber while the wire is hot

The next step is to make the stem which supports the filament in the lamp This consists of a "flare tube" or base through which lead in wires pass to carry the current to the filament, and a "cane" or solid glass stem with "buttons" at top and bottom to hold the wire hooks that finally support the filament

The stock for the "flare tubes" comes from the glass manufacturer as straight glass tubes about three feet long These have to be cut into short lengths The cutting is done by a girl operator who holds a handful against the inverted V shape edge of a carborundum wheel running at 3500 revolutions per minute This quickly snaps off the glass to the right length and a skilled operator with this simple machine is able to cut from 4000 to 5000 flare tubes per hour The wheel of the machine is enclosed and the housing is so designed that a centrifugal exhaust action takes place, sucking the glass dust away from the operator The cut lengths fall into a hopper from which they pass to the hopper of the "automatic flare machine

This machine makes a funnel shaped flare at one end of the tube The tubes are fed from the hopper into indentions in the circumference of a large wheel which carries them under the flames of gas blow torches When the glass is at the right temperature a blunt reamer is projected into the end of the tube shaping it The piece then is discharged into another hopper These machines finish parts for standard vacuum lamps at the rate of about 1500 per hour and require so little attention that one operator can attend to three of them

The "cane" or glass stem is made by a process differing only in that at the point where the flare is made the automatic machine makes two bulges or "buttons" on the stem Next the leading in wires are made These although apparently of minor importance are really one of the deep problems of lamp manufacture Since they comprise the only points at which air might leak into the bulb it is extremely important that the coefficient of expansion of the metal and the glass be the same This is not always possible however because of slight variations either in alloying the metal or in compounding the glass. The old method of preventing leakage was to weld two tiny globules of metal on the wire at the point where it passed through the glass This has been discarded, however in favor of a wire that is simply crimped at this point Leading in wires of this type are produced by an automatic machine at the rate of 100 a minute

With the flare tube stem and two leading in wires complete, the next step is to weld these into a single unit This also is done by an automatic machine On this machine the operator simply places the four pieces in position in a specially constructed head and unloads the completed piece The machine automatically moves the pieces from one position to another first heating the glass and then clamping the pieces to seal them Finally the machine re-anneals the glass to remove strains which might cause cracking

From this point the part goes to an automatic inserting machine which at one operation makes the little wire hooks which are to support the filament, heats the "buttons" and inserts the straight ends of the hooks The final step in completing the stem is the only operation in the making of the lamp which is still a hand process—that of mounting or "draping" the filament in position A girl operator takes one end of the zig zag

Left: Sealing off the lamp, thus forming tip *Right:* Automatic machine for making the glass flare tubes

Two of the very special pieces of apparatus used in the manufacture of the latest electric lamps

filament places it on the end of one lead-in wire and then by means of a small electrical hot-clamp or spot welder, welds the two together She then rapidly drapes the filament over the hooks and welds the other end of the filament to the other lead-in wire The "stem" is then complete.

The glass bulb itself usually comes from the glass maker already blown to shape, excepting that the familiar sharp tip is missing and the base end is large enough to admit the finished stem. The first step in preparing the bulb is to puncture a small hole at the rounded end of the bulb and weld on at this point a short length of glass tubing This tube is for the purpose, later, of extructing the air from the bulb.

The bulb and stem are now ready for final assembly, and this is done on a "sealing in" machine which automatically welds the "flare" to the base of the globe, at the same time reducing the diameter of the globe base and finally shaping the globe. The filament, before being sealed in the globe, has been given a chemical coating, the purpose of which will be explained presently

After sealing, the bulb is placed in an automatic exhausting machine, being held in an inverted position with the tip tube inserted into a rubber bushing A valve is opened which applies a "rough exhaust" to the lamp. This valve is quickly closed and another opened which effects a final exhaust at a slower rate The mercury vacuum pump which was formerly used for this purpose has been abandoned for new types of mechanical vacuum pumps When the vacuum is complete the final sealing of the bulb is accomplished by melting the tube off to the form of a sharp tip.

After exhausting, the lamp is placed in an automatic "flash aging machine" where current is first applied to the filament, being gradually increased until about a 10 per cent overload is applied This burns off the chemical coating on the filament and destroys any oxygen which may not have been exhausted

The final step is to fill the brass base-plugs with a mixture of shellac and cement, apply this to the bulb, and solder on the lead in wires. All of this is done by machinery Then comes final inspection, labeling, and packing in cartons

As intricate as this process may seem, it is quite simple when compared with the manufacture of the newer gas-filled lamps. Although the same general lines of procedure are followed, there are complications from the very beginning

In the first place the filament must be made into the form of a coil of exact specifications. Ordinary coiling methods were found slow and uncertain for this work and so a new machine had to be devised for the purpose The latest coiling machines are capable of running continuously from two to four hours without attention, coiling a filament from four to six thousand feet in length, depending on the size of the wire A coil as fine as a hair, with the individual wires hardly visible to the naked eye, can be wound as easily as the largest motion picture-lamp filaments In the smaller coils as little as 2/1000 inch is allowed for the hole through the center of the coil

This delicate operation is accomplished by first winding the filament wire on a bobbin, which is revolved rapidly about a steel core-wire, the core moving forward at the proper rate of speed The movement of the core wire is regulated by a friction-driven drum, and in making intermittent coils a cam movement causes the drum to "jump" at intervals, producing a jump in the winding The tungsten wire is very brittle and winding at such high speeds would be impossible without heating the wire This is done electrically, the section between the bobbin and the core being kept at a red heat

The continuous filament, with the steel core still inside it, is then taken to an automatic machine which cuts it to the right lengths. In some cases, then, the steel core is pulled out by hand, but usually thousands of them at a time are dropped into an acid solution which dissolves the core, leaving the filament. After removal from the acid the coils are boiled in a sodium hydroxide solution for five or six minutes, washed in dilute

Polishing the finished lamps

hydrochloric acid for about 20 minutes, and finally washed in running water to make sure the coils are free from acid. After drying on a hot plate, the coils are baked in a hydrogen atmosphere (to prevent oxidation) at from 950 to 1050 degrees Centigrade for eight or ten minutes. This is done by placing the coils in an electric circuit and holding them inside an inverted nickel cup, containing hydrogen, or by baking in a small electric furnace. Some types of coils are shaped at the same time by hanging weights at proper intervals during the baking or "flashing" operation. As a final step the coils are inspected. A projecting lantern with a microscopic lens is used The coils are placed on a glass plate and their image projected to a screen, with a magnification of many thousand times. The inspector is able easily and rapidly to pick out defective coils by this method.

Other operations on the gas-filled lamp differ only in detail from the vacuum lamp until the operation of sealing the tips is reached. Here the lamp is exhausted in the usual manner and then nitrogen gas is admitted and the sealing is completed.

Greater speed and perfection in manufacture are attained ofttimes by combining in a single operation two or more of the processes described heretofore For instance, the sealing in and exhausting is combined in the latest installations. The sealing in operator places the sealed lamp in a rotary oven which at once prevents the glass from cracking after application of the blow-torch, prevents moisture from gathering inside the globe, expels about half the air by heating it, and finally carries the bulb to the exhausting operator Since the exhausting machine works at about the same speed as the sealing in machine the two operators keep pace with each other and are able to complete from 200 to 225 lamps per working hour.

The making of miniature electric lights, such as are used for automobile headlights and pocket flashlights, presents a particularly difficult manufacturing problem. The ordinary machinery for standard lamp making is used as far as possible, but more hand work is required on this type of lamp than any other.

The accuracy of the manufacturing methods is tested in any case by taking an occasional lamp from the regular production and testing it for candlepower and for the whiteness of its light by means of a spectroscope. Both tests are combined in a single machine called the "spherical photometer," which is provided with a system of curved mirrors and lenses, a screen and a series of disks which indicate to the expert operator the qualities of the lamp.

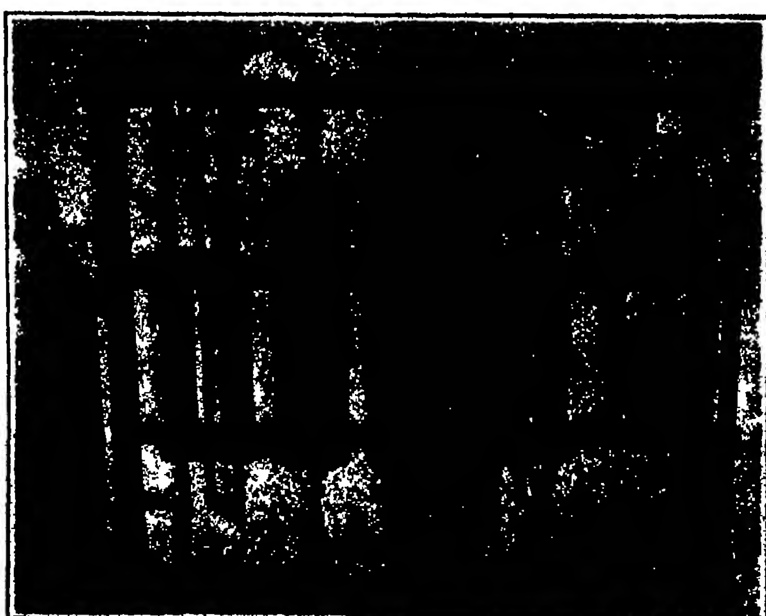
The tendency in lamp manufacture is toward even greater application of automatic machinery Indeed, it requires no great stretch of imagination to give credence to the statement that the day is not far distant when electric lamps will be made without the touch of a human hand.

While one great centralized group of scientists works to the end that the lamp itself shall be a more efficient servant, other groups are keeping pace in manufacturing by designing machinery that will turn out the lamps cheaper and of more uniform quality The very fact, however, that lamp-making machinery is of such an intricate and highly specialized nature forbids frequent changes in lamp design. A complete change of lamp model would involve the scrapping of many thousands of dollars' worth of machinery in a large lamp factory. It therefore happens that while small improvements are being constantly made in lamp design, radical changes occur only at rare intervals when laboratory development has proceeded so far ahead that a change is imperative.

As a matter of fact, scientists in the great lamp laboratories could probably show us today, if permitted to do so, electric lamps which burn only a fraction of the electricity consumed by the appliances now in common use, and which outlast present-day lamps many times in service As soon as the balance of economics permits, and after most rigid tests prove beyond a doubt the ultimate value of such inventions, then we shall have them in our homes.

The Effect of Internal Secretions: Why We Are What We Are

THE relation of the glands of internal secretion, commonly known as endocrine glands, to human development and human behavior is becoming daily more obvious. Stature, build, proportions; details of development of bone, teeth, nails, hair, skin; intelligence, emotional control all these things can be shown to be influenced by endocrine secretions. Indeed, it seems naturally to follow that the hereditary differences between people are due to hereditary differences in the activity of these glands. These glands, as is well known, secrete substances called "hormones" which regulate our physical, mental and temperamental constitution The special quality and quantity of these hormones is determined by the idiosyncrasies of the enzymes of the germ cells. The hormones that determine our personality constitute the bridge that connects this personality with the specific enzymes packed away in the chromosomes of the germ cells. You and I differ by virtue of the difference of atomic structure and atomic activity of the enzymes and hormones which make up that part of the stream of life-yeast which has got into and is activating our protoplasm and will activate that of the fertilized egg that results from us and our consorts. Thus each is what he is in his physique, in his thoughts and in his reactions largely by virtue of the peculiar properties of these extraordinary activating substances, which are specific for him and other members of his family and race or biotype. The future of human genetics lies largely in a study of these activities, and the origin of differences or mutations in them.—*Abstract from an address by Dr. C. B. Davenport before the International Congress of Eugenics, New York, October, 1921.*



The compressed-gas tanks from which the bulbs are filled, and the washing machines that purify the gas before it goes into them

U.S.S. "Wright"—Our First Balloon and Airplane Carrier

THE United States' first balloon and airplane carrier is nearing completion at the Brooklyn Navy Yard This vessel has been remodeled from the U.S.S. "Wright," designed originally as a transport. She was very fittingly named in tribute to the late Wilbur Wright, who, cooperating with his brother Orville, was the first to fly in a heavier-than-air machine, and from whose genius the development of aviation derived so much of its impetus.

The "Wright" is one of the ships built at Hog Island for war service. In her new capacity her chief usefulness will be in handling balloons and as a tender for seaplanes at sea, and in this respect she will be unique among fighting craft, so far as the U. S. Navy at least is concerned. To put the "Wright" into condition an amount of reconstruction proved necessary which did not fall far short of the building of a new interior Except for the engine and boiler room, the whole interior of the ship has been altered and fitted out to meet the new demands made upon her

In the after end of the vessel is something quite new on ship board, a balloon well 100 feet long, 40 feet wide and 30 feet deep. Farther aft is a stowage space for another, smaller ballon, and also a plant in which hydrogen gas to inflate the balloons will be generated. The balloon wells are protected from the weather by sectional hatches, which can be shifted into position by a trolley which runs from the deckhouse to the stern At the forward end of the ship a large machine shop has been installed, fitted with everything necessary for the repair of the planes and balloons. There is a generating plant, also tanks for hydrogen, and stowage space for spare wings and parts. An aerological laboratory has also been provided, as well as a fully equipped photographic laboratory Electric motors will operate much of the machinery and other equipment of the ship.

The actual fighting equipment of the "Wright" will consist of only four 5", 51-caliber guns, two forward and two aft, also two machine guns. It has been decided that naval armament of any consequence on an airplane carrier is really quite unnecessary because, as Admiral Sims has shown, these boats will never be called upon to take an active part in any conflict, their fighting seaplanes affording all the protection they need. When an enemy fleet is at least 100 miles distant, the airplane carrier will receive word of its approach, and she need not steam into close proximity to the hostile fleet She will remain out of range of its guns and dispatch a squadron of her planes to meet the enemy. Circling over the fleet, these planes will proceed to battle by dropping their bombs on the hostile ships.

In a recent experiment the old U.S.S. "Indiana," while anchored, was made a target for bombs from airplanes. The fall of every bomb was carefully plotted on a map. [illegible] the ship's deck and [illegible] more fell within the danger zone. Some of the planes swooped down and circled around the vessels until they were only about fifty feet above the water, and then they let fall their torpedoes. To the landsmen it would appear an easy matter for the ship to attack an airplane flying a few hundred feet above the water But the gunners on the battleship have no means of calculating the distance of the airplane, and would have to shoot at sight, with the planes traveling perhaps 150 miles an hour They would be in the position of a man shooting at wild ducks or partridges. The chances of the gunners scoring a disabling hit under these conditions are rather remote At the greater heights of 7000 to 10,000 feet, the hits might be only one in a thousand, this being the exact proportion of hits scored by anti aircraft guns during the war

Statistics compiled officially in a recent tabulation of the relative merits of warships and air crafts showed substantially the following results

(a) As regards first cost, a modern armored warship, with the accessories, costs more than $45,000,000, one bombardment airplane, capable of carrying from three to five bombs, costs $45,000, wherefore, 1000 bombardment airplanes can be constructed for the cost of one battleship

(b) The recent war has demonstrated that projectiles are efficient in accordance with the amount of explosive carried. The projectile from a heavy gun carries from fifty to sixty pounds of explosive, the one-ton bomb carries from one thousand to fourteen hundred pounds of explosive An air projectile, therefore carries more than twenty times the amount of explosive carried by a cannon projectile.

(c) An airplane travels from 100 to 200 miles an hour, a warship travels from 20 to 50 miles an hour—the speed being four to five times greater for an airplane than for a warship

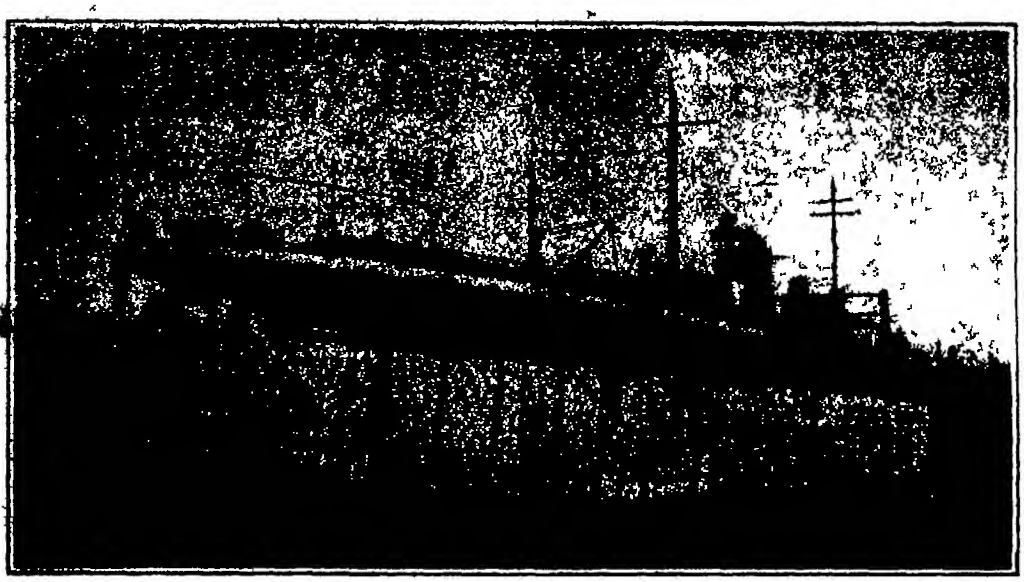
Many naval officers believe that the most effective warship of the future will be a mother ship or airplane carrier such as the "Wright," but, of course, larger and faster Such a ship will have a speed of from 30 to 35 miles an hour Instead of being crowded with guns she will be devoted to the storage and launching of seaplanes and balloons

In England, men of the royal air force, ever since they returned from the war, have not hesitated to tell men afloat that they would not, in the next war, give a straw for all of Great Britain's boasted superdreadnoughts and cruisers that she may build between now and then The advocates of the fleet have just as warmly insisted that they could take care of themselves no matter what the flyers essayed. The controversy finally led not long since, to a request that the Admiralty detail a squadron of representative ships for an offshore mimic combat with a force of bombing machines

This was agreed to, and when the time arrived the airplanes mounted high into the sky, where they could not be seen, and where the hum of their motors would not betray them There far beyond the reach of the guns of the so-called foe, they dropped smoke-making missiles on the sea, and in an astonishingly short while they created a barrage that closed about the vessels, causing much uncertainty

While the ships were still guessing and contending with the smoke screen, the bombers swooped down on the hampered craft and launched dummy projectiles, simulating bombs When the whirlwind assault had ceased seven of the squadron were declared hors de combat, or sunk by airplanes. None of the machines was theoretically sacrificed.

But, though the experiment is strongly suggestive it is not absolutely conclusive



Quartering view of the U.S.S. "Wright," showing the exterior of the well in which the balloon is housed

Our first aircraft mother ship

Interior view of balloon storage well of the "Wright"

Note the remarkable roof of the balloon well, with sections removed showing interior

View looking down upon the U.S.S. "Wright"

Inventions New and Interesting

A Department Devoted to Pioneer Work in the Various Arts and to Patent News

The shockless—speaking relatively—motorcycle seat

A Shock-Absorbing Saddle

MOTORCYCLE seat suspension is ordinarily a rather simple business, not materially different from that of the old fashioned "bike" save in its provision of stronger springs to take the heavier rebounds caused by the higher speeds. What appears to be a rather carefully thought out effort to improve the riding qualities of the little brother of the automobile is illustrated herewith. The usual compression springs are seen immediately beneath the saddle between it and the rear frame-tube. In addition to these, however, there is supplied an elaborate series of springs joining the saddle to the upright tube of the frame. It will be noted that the short pillar-tube that carries the saddle immediately is swung on the frame-pillar entirely through these springs, with the double rocking lever that accompanies them. These suspension springs at the fore of the saddle play against one another and against the rear compression springs in such a way that abrupt rebounds are checked more effectually than is the case in the ordinary design.

Huge Roller Bearings Carry Big Doors

THE hangar doors in the dirigible shed at Lakehurst, New Jersey, are carried by remarkably large roller-bearing journal boxes. The doors are of structural steel, and two doors are located at each end of the building. Each door weighs 8500 tons and is 185 feet in height and 165 feet wide. Measuring 15 feet through at the base the doors are weighted at this point with concrete and steel to offset wind pressure. Unlike most sliding doors suspended from tops of buildings, these doors are entirely independent of the hangar building and run on four eight wheel trucks operating on two standard gage railroad tracks. Each truck is operated by an electric motor and a hand windlass is supplied for emergency use.

Thirty-two journal boxes are required for each door, and the weight of each bearing with the cast steel housing is 892 pounds. The load capacity of each bearing is 150 tons at one revolution per minute. Without the housing the bore of the bearing is 7 inches, outside diameter is 13¼ inches and its width is 6½ inches. It is claimed that the doors carried by these bearings are the largest unit load ever carried upon anti friction bearings. The bearings themselves are sufficiently imposing, as indicated by our photograph.—*By A. P. Child.*

The roller bearings for the Lakehurst, N. J., hangar doors

Air Takes the Place of Metal Springs

A NEW air spring device developed by a California concern eliminates the use of metal springs and shock absorbers. Wherever spring action or suspension is necessary it is claimed that this device may be applied. The air spring consists of an inner tube, within a fabricated rubber cushion and a metal casing. A metal deformer at the bottom serves to fold the casing walls inwardly without crimping in such a way that the maximum of wear is obtained from the casing. The inner tube is filled with air according to the weight placed upon the top of the metal casing. The device is claimed to give better results, especially for light service like that illustrated, than the more usual springs.

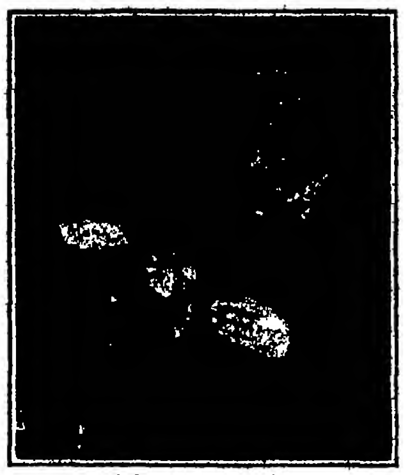
A Key Chain That Stretches

THERE are times when the user of a key ring and chain wishes the chain were longer. With one such as this, those wishes will come true, for the chain is made of coiled piano wire and will stretch a considerable distance.—*By M. M. Hunting.*

The extensible key-chain

A Machine to Break-in Your New Pipe

NEW YORK boasts a dog who advertises a certain brand of tobacco by promenading about the streets or posing on window ledges, pipe in mouth and advertising placard over his back in the form of a blanket. We have listened in on acute arguments whether the animal were really smoking the pipe or just carrying it. London, however, has a machine which gives no such opening for controversy. It smokes a pipe, and leaves no doubt that it is smoking one. A tobacconist invented it and set it up in his store as a pipe advertisement, and claims that it has sold hundreds of pipes for him by attracting trade and by actual service. The non-smoker will have to have it pointed out to him that the proprietor of an old pipe frequently postpones to the last possible day the buying and the "breaking in" of a new instrument, the pipe smoker will need no argument to convince him of the value of a machine that will smoke his new pipe for him until it begins to taste like a pipe. According to our photographer, the proprietor of this ingenious machine refers to it affectionately as "Adolphus."



"Adolphus" smokes his pipe

Models vs. Full-Size Planes

INVESTIGATION of the pressure distribution over the horizontal tail surfaces of an airplane was undertaken by F. H. Norton and D. L. Bacon in order to determine whether the results obtained upon model tail surfaces can be used to predict accurately loads upon the full-sized tail, and also to find the distribution of load when large elevator angles are used, as the loads from such angles cannot be obtained readily in free flight. The method consisted in using a metal horizontal tail surface inside of which air passages connecting with a series of holes in the surface, led the pressure off from the tail in rubber tubes. In this way the pressure at each of these holes was measured by a manometer at several angles of attack and several elevator settings. The results show that the model tests give a loading which is equivalent to the loading under similar conditions in the full sized airplane and that the manner of distribution is quite similar in the two cases when there is no slip stream. A copy of Report No. 119, detailing these findings in full with many drawings, may be obtained upon request from the National Advisory Committee for Aeronautics, Washington, D. C.

Air-cushion device of a novel character to replace metal springs

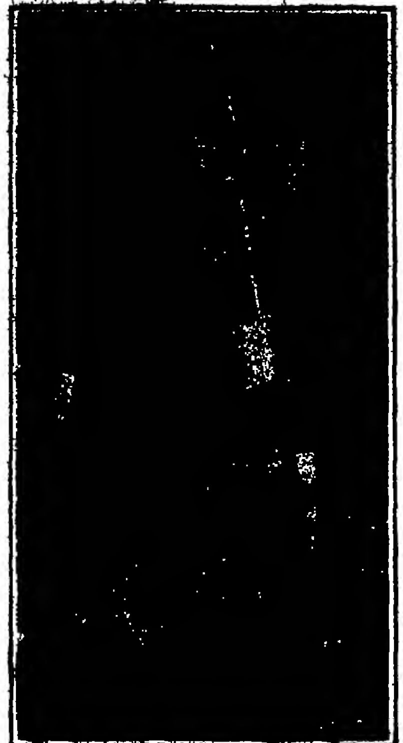
New Ice Machine of Paris Make

WE illustrate one of the most recent Paris productions in the way of a small and compact ice machine of patented design. It will freeze a carafe in about a minute, simply by turning the handle, and good-sized blocks of ice may be produced in a very short time. It is intended principally for domestic use, or again for medical purposes, in hospitals or laboratories, and like purposes. Outside of ordinary uses, it will be most convenient for scientific operations, as enabling quite a considerable quantity of ice to be furnished, and especially without any previous care or preparation, for one excellent point about the new apparatus is that it can be set to work at any time and is always in condition to operate.

The apparatus comprises a small air pump as seen on the right of our photograph, which can be operated by hand or by electric motor. This pump is of an improved type and is partially filled with a light oil. It is connected with a good-sized removable receptacle which contains about two quarts of concentrated sulfuric acid. A small safety chamber is disposed as observed between the pump and the container to keep these two parts properly separated and to prevent their contents from passing from one to the other. The middle container is connected by a tube with the carafe or the like whose contents are to be frozen. After pumping for about one minute, the water in the carafe will be entirely frozen. In this device the freezing action is brought about by the rapid evaporation of the water itself in the vacuum which is produced by the pump, the water vapor being absorbed by the sulfuric acid as fast as produced, so that an extremely rapid evaporation of the water is set up, resulting in an intense cold.

To obtain a block of ice, it is preferable to make use of a special metal cylinder which is substituted for the carafe but is at first empty, a tube connected to the same being plunged into water contained, for instance, in a bucket. When the vacuum is produced the water gradually enters the cylinder or ice-mold through the outer connecting tube and becomes frozen within the cylinder, so

A hand-power ice machine of French design



Combination of instantaneous water-heater and tea-ball

that after about ten minutes a two-pound block of very solid ice can be obtained which is turned out of the mold; and of course, this operation may be repeated indefinitely. As will be observed, this apparatus is of very compact and simple make-up, and of an inexpensive nature. It can be operated by any person and without requiring the renewal of any material except the sulfuric acid, which loses its concentration as it becomes charged with water, but this product is one which may be obtained without any difficulty, and besides costs very little. For making ice cream or ices it is understood that the machine is first employed to produce blocks of ice as above mentioned, and these are broken up as usual and employed in the ordinary ice cream freezer.

As a matter of scientific interest, it may be stated that even though the device depends for its operation upon the absorption of the water vapor by sulfuric acid it is found after conclusive official tests carried out at Paris that it will work quite as well in a dry atmosphere as in one which is saturated with moisture. Experiments made at a temperature as high as 50 degrees Centigrade showed excellent results, which proves that the machine is adapted for use in all countries.—*By Francis P. Mann.*

Combining portable and stationary features, this drill has a wide range of use

The Electric Tea-Ball

As modern invention turns out one ingenious device after another, the possibilities of combining two or more familiar inventions into a piece of apparatus of multiple utility are always increasing. The electric heating element is one invention, and the tea-ball is another, and now we have the two combined into a single unit. The tea ball is filled and placed in the water, as usual, only now it is on the end of a cord. The switch is turned, and the heater, which is of the immersion type, gets busy. In short order the water is boiling and the tea infusion is ready for the table.

Steel Joint Replaces Rubber Dredging Sleeve

Since hydraulic suction dredges were put in operation it has generally been found necessary to use rubber connections between the long pipes that are carried on pontoons. These rubber connections are not very satisfactory, as their life is very short and they require constant attention to prevent leakage along the pipe line. The illustration depicts the flexible steel joint as attached to a pontoon pipe-line. This joint is of very rugged construction and will actually outwear the pipe-line itself. By reason of a long-lipped rubber ring embodied in their construction, these joints will not leak, in fact, the higher the pressure in the pipe-line the tighter it becomes. Another ingenious feature is the locking device, which can be clearly seen in the illustration. This is in the form of a loose ring and one man can easily connect and disconnect the line almost instantly. This is an important feature as there often are as many as 50 pipes (and 50 connections) on one line.—*By Wm McInn.*

The Universal Flashlight

This flashlight may be hooked to the belt of a watchman, the fender of a car, the vest pocket of anyone, or any

Flashlight that may be hung to point in any direction

other place that is convenient or expedient. The hook moves on a ratchet, which locks wherever set. It is an exceptionally practical type of night lamp for its rays may be pointed and maintained at any angle.

The Portable Stationary Drill

Portable electric drills can be used conveniently at times when attached to a bench stand like that shown which has a vertical column 1 7/16 inches in diameter supporting the movable drill bracket. The coiled spring forces the drill upward when not being used.

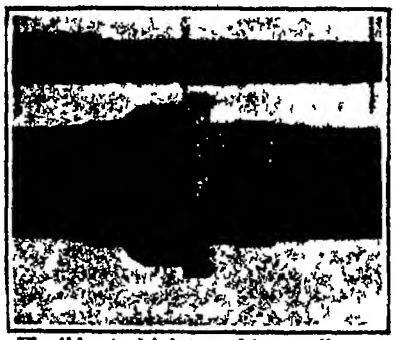
The necessary downward movement is produced by means of a lever, the arms of which are in the ratio of six to one so that a pull of 100 pounds on the long arm will produce a drill pressure of 600 pounds, or a sufficient amount for ordinary operations. Fast work can be turned out with very little effort.

If the work is too large for the bench the drill bracket can be swung around the vertical column and clamped in the desired position for operating upon objects on the floor. The ends of axles and other high objects can be drilled in this manner.

An adjustable drill table, suitable for small work on the bench, can be clamped to the standard when needed. Drills of this kind are a big addition to any shop, on account of the wide range of usefulness and the ease of operation which it embodies.

A Better Stamp Moistener

The end of this metal stamp affixer and letter sealer is heavy enough to prevent its tipping down and leaking water. When it is placed on a table it will automatically spring back with the moistened felt end elevated. To fill with the necessary water the ball end is unscrewed in the center, filled and securely screwed together again. Its inventor claims that it will not get gummy as many such devices do.



Flexible steel joint used in coupling up dredging pipe-line

Gasoline Gages for the Dashboard

The need of a practical, inexpensive device for accurately registering upon the dash the amount of gasoline in the tank has long been felt by every driver of an automobile. A number of these have been offered in the past; one recently marketed appears to be sufficiently distinctive to merit chronicling. It is built for every type of car except those having the gas tank inside the cowl. It is made in two sections—the indicator in the tank, and the meter proper located upon the instrument board.

The indicator consists of a copper, air tight float, attached to a steel shaft and its operation is similar in principle to the usual form of gasoline gage. The float rises or falls in the tank as the gas raises or lowers. This operates a shaft within the main indicator shaft through the medium of two brass milled bevel gears. This shaft is mounted upon two bearings. The inside shaft actuates an arm within the indicator head, and causes it to touch upon electrical segments, separate and distinct for each division of the gasoline supply.

This indicating apparatus is inserted in the tank in place of the present gasoline gage. From it is run a linen bound waterproof cable containing five wires, which passes under the car to the dash instrument. A connection is established between the dash instrument and the ammeter, and when the button in the center of the dash instrument is pressed the height of gasoline in the tank is shown by means of an illumination under the section of the dial which corresponds to the height of gasoline in the tank. Both eighths and quarters register on the meter. When the tank registers 1/8, both empty and 1/4 burn. When 3/8, both 1/4 and 1/2 burn.

The General-Utility Alarm Clock

Alarm clock attachments for closing the windows when the clock goes off in the morning, or for turning on the furnace drafts, are an old story. But if the thing is feasible on a small scale like

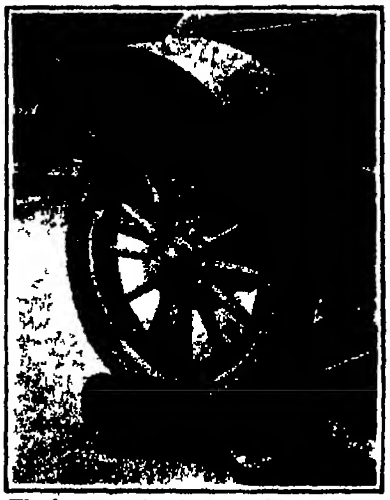
This stamp-licker is always moist

that, reasoned Walter Smith of Philadelphia, it can be equally used to bestow all the comforts of a home upon bachelors and lazy married folk who cannot afford a cook, but who like to have breakfast ready for them, steaming hot, as soon as they finish dressing in the morning. The Philadelphian has solved part of this problem by an apparatus consisting of an ordinary alarm clock, a single dry cell battery, and a few springs and weights.

With this combination he has perfected a machine that sounds an alarm, lights a fire under a pot of water and pours the water into a pot containing tea or coffee when it reaches the boiling point. Then the alarm is sounded for the second time. The inventor is now working on an attachment to boil eggs, which he asserts is a simple matter. In its present form the apparatus also lights the gas, with which Mr. Smith's house is equipped, or can be used to snap on an electric switch, thus making doubly sure that the owner will get up after the first alarm.

As shown in the accompanying illustration, the contrivance looks something like an old fashioned clock. The alarm clock is set in the top of the box. When the alarm goes off it pulls a cord that releases a weight. This drops in such a way as to strike a match just over a shallow pan containing cotton soaked with alcohol. It also strikes a spring that turns on the gas which is ignited by the usual electric sparker. The pot

The clock that lights the fire and starts the breakfast



The latest style of power shaft for use with automobiles

containing the waiting water is balanced delicately over the pan of alcohol When the water boils and rises in the pot, the center of gravity is shifted and the pot tilts forward, permitting the water to run into the pot containing the tea or coffee. A tripper device drops a snuffer over the burning alcohol as the pot tilts, extinguishing the flame. Then, as the pot is emptied and swings back into place, it strikes another switch tripper that operates the alarm for a second time, this time by electricity furnished by the dry cell.

The attachment to boil eggs will be simply a duplicate of the heating apparatus without the balancing feature, the flame to be turned off by the owner when he determines the eggs are sufficiently boiled.

A New Power Take-Off for the Car

MOST devices for using the automobile as a stationary engine require either the jacking up of the rear end or the removal of one or both rear wheels. The one which we illustrate is free from both these necessities. The car is simply backed up the inclined runway until the rear wheels drop into the cradle formed by the two small driven wheels of the auxiliary mechanism at each side

These little wheels are not so flimsy as the photograph suggests. They are formed from heavy pressed metal, each half being made separately and the two then riveted together in the center The reason for this curious construction is of course the desire that the wheel shall form a cradle for the rear wheels of the car, without possessing itself the excessive weight that it would have if solid.

The total weight of the entire auxiliary apparatus— driven wheels, shafts, runways, etc.—is but 163 pounds. It is amply heavy enough to transmit the full power delivered to it, but still light enough to carry around readily The only strains on the car when it is driving machinery through this male are the ordinary ones of road driving. On account of the small diameter of the driven wheels, a "road speed" of 12–15 miles per hour by the rear end of the car will deliver power to the shaft at very high speed.

The rear shaft is the power shaft and the forward one is an idler If more work is put on the power shaft than it can properly deliver, the car wheels will merely be thrown forward off the power shaft and on to the idler instead of out of the cradle entirely When it is desired to move the car off the cradle, the power shaft is locked by means of a pawl and the thing is done at once. The driven wheels will take any tire up to five inches.

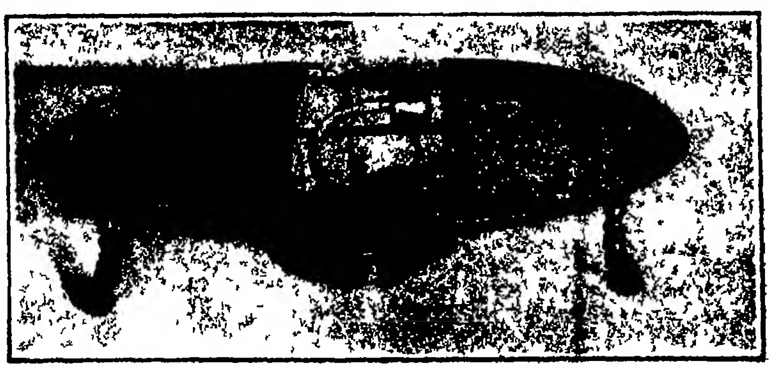
A Tickless Timepiece

TO tell time with this timepiece it is necessary that the sun shine It is a sun watch On the inside cover of the watch various latitudes are given. The latitude nearest your location is noted. The style, or small pointer which is seen casting the shadow on the dial, is then lifted to the angle 35, 40 or 45 degrees, the one most nearly corresponding The variation of the compass is then noted, and the sunwatch held in a horizontal position, and the compass needle pointing to that number of degrees east or west. The sun watch will then be in correct position and the style or pointer pointing to the true north The shadow thrown by the style will be sun time. Mean time can be determined by adding to or subtracting from sun time the number of minutes shown on the equation table for the most nearly corresponding day of the year This table is shown on the inside cover of the watch.

A pocket sun-dial—the tickless watch

Serving Tray Plus Stove Standard

THIS metal tray may be opened out like an extension table. In that position it serves in effective combination with an alcohol stove, which is clamped to it. The stove may be quickly removed, the tray closed, and the tray is ready to perform its more conventional function.



Apparently an ordinary tray, it opens like an extension table and is used as pot holder with an alcohol stove

The bumper that turns into a tow-line when emergency calls

Combination Bumper and Tow

BY means of this device the bumper can be converted into a towing device in less than a minute, and vice versa. The bumper is provided with two arms which are adapted to fit into sockets attached to the front of the springs by a swivel. This arm fits into the socket just like the ends of the old fashioned iron beds. The arms are adjustable, adapting the bumper to all sizes and types of cars.

The wabbling grinder

At one end of the bumper there is an arm, attached by means of a universal joint. When the device is to be used as a towing bar this arm is inserted into one of the sockets. At the other end of the towing bar there is a strap, about 14 inches long, made of woven wire belting. This is for attaching the tow bar to the rear of the car that is to do the towing.

There is also a rubber bumper to protect the car that is to do the towing. This rubber bumper is provided with two slots through which the towing strap passes. After the belt has been passed around the rear spring of the towing car the free end of the belt is securely locked to the end of the towing bar by means of a cam lock This is so arranged that the harder the pull on the strap the more firmly is the belt held.

The belt, the locking device and the arm at the other end of the bumper are all arranged to fold up into the bumper in such a manner that they cannot be observed when the device is used as a bumper Every driver knows he ought to carry a tow-line with him, but the inconvenience of doing so leads to its frequent absence. When they come as handy as this one, however, there is not much excuse for being without one.

Sweetly Scents the Room

A RATHER novel device for the home is this perfumer, which is used in connection with electric light bulbs. The brass cap on the top of the globe is hollow. It is filled with water and a few drops of perfume placed upon it. When the light is burning, heat produced by the heated globe will evaporate the perfume and send it throughout a room. For the sick room it will be found a convenience, as well as when cooking odors have permeated an apartment as they sometimes do. Two designs are made, one as shown and a second to fit an inverted globe.

The Chemical Windshield Wiper

WINDSHIELD wipers are an old story; and so are chemical preparations which more or less satisfactorily make the surface of the glass repellent to water. Of somewhat better claim to originality is the combination of the two, so that the wiper, suspended from the top of the windshield in the conventional style, has for its bearing surface a chemically treated felt. The combination has the advantage over the untreated rubber scraper that it does not call for the so frequent detachment of one hand from the business of driving the car—the more ticklish in direct ratio with the frequency of the demand. It is superior to the mere chemical wash that is applied once to the glass, before starting, in that when renewal is made necessary the means of instantaneously accomplishing it in a tried and familiar fashion are at hand.

A Wheel That Grinds with a Peculiar Motion

A GRINDING wheel designed for grinding extremely thin pieces of steel in a Connecticut factory has a peculiar wobbling motion in operation. A standard grinding wheel was mounted in the usual manner in making this grinding wheel and dressed down so as to leave a very narrow face. A pair of collars was keyed to a sleeve after the collars had been machined so as to make it possible for one face of each to form an angle of 15 degrees with its axis. Being keyed to the sleeve, eliminated the possibility of their changing their relative position. A ring nut with holes provided for using a spanner holds the combination together in use and when the lead bushing is scraped out of the grinding wheel it tilts to an angle corresponding to that of the collars. The nut that would hold any other wheel on the spindle takes care of this one.

The action of the wheel presents contacts which progress back and forth over the work in right angles to the advance-

Perfuming the room from the electric lamp bulb

The point of this scorching pencil carries heat, but no current

ing movement of the piece of work on the table. Owing to the fact that solid lines of the wheel disappear, the work is always in view of the operator

It is claimed that, in using a larger, solid wheel for grinding precisely such small pieces of steel which were required to be one inch square and 1/32 and less in thickness, there would be the danger of brushing them off the chuck or that if they were held sufficiently long they would be overheated. And it would take too long for a very narrow wheel to work over the width of the pieces. So this grinding wheel which presents a surface contact at a different location at every revolution was designed

Rope Strength

TECHNOLOGIC Papers of the Bureau of Standards, No 198 'Results of Some Tests of Manila Rope gives a summary of the results of tensile tests of 368 specimens of Manila rope. Most of them represented material submitted on purchase orders for government departments. They were all three-strand Manila rope, ½ to 4½ inch diameters.

A summary of the results is given in tables and also graphically A formula is given of the breaking load for any diameter of rope

This publication is now ready for distribution and anyone interested may obtain a copy by addressing a request to this bureau until the free stock is exhausted.

To measure the resistance of the soil [illegible] valuable instrument in the hands of our road-builders

Electric Scorching Pencil

A NEW electric scorching pencil will find many uses in business and the various trades. It is of the stylolectric design and as a check protector it is useful and safe Gold and silver letters can be transferred directly on many surfaces by the use of this electrically heated pen Hat band letters can be rapidly written on the inside of your hat, and your correct address can be added if you wish The point especially shaped for the work carries heat but no current Electricity cannot come in contact with the user Physicians and surgeons use the pen with a different point for cauterizing

For the Motorist's Ashes

CIGAR ashes, in windy weather the bane and pesteration of tonneau riders who do not indulge in the weed but get its ashes in their eyes, are now deposited in this novel and decidedly ornamental ash receptacle shown in the view below —*By F G Jopp*

To keep the driver's ashes out of the passengers' eyes

Support for Swing Bridge

AN ingenious application of reinforced concrete at the works of the Société d'Electricité du Brabant Belgium consists of a cantilever support for the end of a swing bridge. The support had to be constructed at the angle of a building in front of which is a roadway used for continuous motor-truck traffic The problem was complicated by the conditions that the roadway could not be encroached upon and that it was inadvisable to disturb the foundations of the building. The solution was found in the construction outside the wall of a pilaster founded upon an extended base and provided at the top with a cantilever cap projecting two meters from its support at a height of four meters above ground level Above the base the pilaster and cantilever projection consist of two members side by side connected at the top by a slab 20 cm thick and braced at intermediate points between the base and the cap by transverse members.

Testing the Underpinning of Our Roads

A SIZE-TWELVE brogan shoe can easily plant itself in soggy soil to no avail but an artificial foot ten inches square delivering blows from a ten foot drop on the surface of a highway is a serviceable instrument Reference is made to a tripod like subgrade tester recently designed by the United States Bureau of Public Roads The device weighs approximately 40 pounds and its ability to penetrate the soil, measured in inches, is a determining factor in appraising the value of the subgrade of the roadway being tested

An elongated rod has a foot ten inches square, on the former being a weight which may be moved up and down The whole contraption is supported loosely in a tripod, with a vernier measuring scale at the top. In service the apparatus is set up over the soil to be tested, and the sliding weight is raised and dropped from a height of ten feet. Fifty blows are delivered in rapid succession to the subgrade and the penetration of the foot into the soil is revealed in inches on the vernier measuring scale.

A Mechanical Fruit Ladder

A LADDER which speeds up and lightens the labor of harvesting all manner of tree crops is the patented invention of Mr E A Bixler of Alhambra California Mr Bixler who is an orange grower himself sought to produce some sort of machine which would simultaneously enable a fruit picker to get at his fruit and also lower it to the ground in the process of picking without bruising or otherwise damaging the crop

The mechanical fruit picker's ladder combines the wheelbarrow idea for moving the device about the trees and through the orchards, with the step ladder and endless conveyor belt for lowering the fruit to the ground

The device is placed near the tree, and ascending the ladder the operator picks all the fruit within his reach The picked fruit is merely placed in the metal buckets of the conveyor belt—and gravity does the rest. As the buckets turn over at the bottom of the belt the oranges, or whatever the fruit may be drop out into a canvas apron From there they are transferred to a lug box placed on a platform beneath the apron

The device speeds up the fruit harvest by reducing the labor Simultaneously the fruit is handled with less damage than attends most hand picking methods It is adaptable to any kind of fruit that grows on trees such as oranges lemons, apples, peaches, cherries, etc

Punch with Detachable Gage

IN order to overcome the difficulty of punching holes from the edge of metal varying depths apart the inventor of this punch has provided a detachable gage It has punches and dies in six sizes from 3/32 to ¼ inch by 1/32nds It has been especially designed for the lighter sheet metal work of tinners with a capacity ¼ inch hole through 18-gage iron It will punch a hole to the center of a 3¼ inch circle It is but 8¾ inches long with a weight of but 2¼ pounds

The punch with a detachable gage

Soap and Brush in One

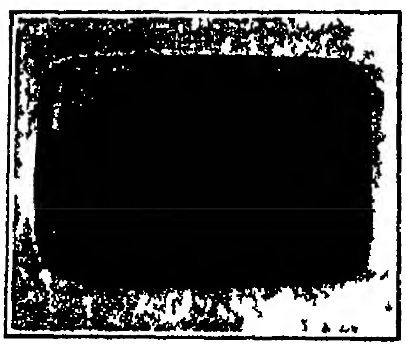
SOAP and brush go together in use why not in manufacture and sale? The manufacturer of the little novelty illustrated herewith asked himself this question and agreed with himself that there was no answer So we have the combination on the market today and may enjoy the privilege of washing our grimy hands without separately picking up and applying soap and brush

Lumber Company Has Efficient Delivery

A PROMINENT lumber company of Davenport Iowa delivers ready cut buildings and lumber all over North America, Cuba and the Philippine Islands. The inner circle of this transportation system served with motor trucks is a model of perfection It has been built up around the nucleus of a 2 ton truck purchased years ago when motor truck delivery was in its infancy The old truck is still giving excellent service delivering its quota of building supplies every day The company has studied motor truck transportation very carefully Another 2 ton machine has been added The two now take care of all the heavy work and together with seven other lighter trucks making a fleet of nine duplicate the activities of about fifteen vehicles working under ordinary conditions To state this more clearly if the nine trucks were not so carefully routed and despatched loaded and unloaded cared for and driven it would take fifteen trucks to deliver the same material in the same time and keep the customers satisfied The motor truck fleet is operated solely for the purpose of delivering building materials in the territory comprising Davenport Iowa Rock Island Moline East Moline Silvis and Watertown Illinois The territory is on both sides of the Mississippi River in two states and is populated by about 250 000 persons A brief description of the mechanism by which these trucks do the work of a larger number cannot fail to be of interest

Each truck instead of having the regular platform is equipped with cross rollers The rest of the loading equipment is arranged mostly on the loading platform It consists of crib bodies and crib racks The crib bodies are loaded while resting on the crib racks and are then rolled on to the trucks The material is loaded into the crib bodies in station order so the load for the last stop is the first one put on The entire delivery district is divided into eight smaller districts, numbered from one to eight They are so arranged that a route following through the districts from one to eight consecutively would be a continuous route with no cross-over on the back trail All orders are stamped with numbers one to eight according to the districts to which they are to be delivered The loading platform is also divided into eight parts The

Speeding up the fruit harvest with a mechanical ladder



The finger brush is now part of the cake of soap

A meat broiler of new design, intended for better conservation of the juices

orders are simply put in the division that bears the same number and so the system works throughout

The first truck in slips off its empty crib body and swings over in front of the loaded one The platform men roll the body on the truck, give the driver his delivery tickets and he is off on his next trip in five minutes Loading by hand usually requires one and one-half to two hours of hard work for driver and helper Feeder wagons, equipped with rollers to facilitate the transfer of lumber from the wagons to the trucks, are used in the yard The load is assembled by pulling the wagon from one lumber pile to another with a small gasoline tractor It takes five minutes to roll the lumber from the feeder wagon to the truck The load, secured by a chain binder to prevent scattering and breaking, is rolled off the truck at its destination in ten minutes. The driver can unload the truck without a helper Unloading by hand, piece by piece, in the usual fashion, requires about as much time as loading

An overhead derrick is also used to load the smaller trucks out in the yard The load is assembled on a lumber dolly and pulled under the derrick Then with chain slings, it is picked up and swung free The dolly is removed and the truck run under the suspended load The lumber is lowered to the truck and the outfit is on its way in ten minutes The 2 ton trucks frequently carry all the material to start a house or barn 15 or 20 miles out into the country, having it on the ground in a day or so after the order is sent in

Extension Crank Makes Starting Easier

AN extension crank recently brought out gives six inches additional leverage which is a decided advantage in cranking certain automobiles and tractors The extension handle or crank is not permanently attached, but slips on readily over the crank attached and locks by a curved lip which extends backward

Longer crank, easier start

Makes for Healthier Stomachs

THOSE who look after our physical well-being tell us that broiled meats are kinder to our stomachs than those that are fried. The juice is kept intact so that it is more beneficial A new device for broiling meat has been invented that is said to be smokeless, and catches all juice, broiling directly over a low gas flame The new broiler is made in two sections, of a series of grooves, which catch the juice as it comes from the meat and direct it into the deeper groove which surrounds the raised sections. The upper section is removable for cleaning The material is aluminum

Device Cleans Outsides of Cans

THE accompanying photo shows a device used in canneries for quickly cleaning the outside of canned fruit, after the cans are taken from the cookers, where more or less material gathers on the outside of the cans. It consists of a pulley with four brushes attached to the inner circumference of the pulley This pulley revolves at the rate of one thousand and two hundred revolutions a minute The operator holds the cans in the device for five seconds. This rapidly revolving pulley is almost entirely covered by a safety device which guards the workers from being injured The device has a funnel-shaped opening into which the cans are inserted. The pulleys carrying the brushes are operated by individual electric motors. The equipment is installed on a table which can be easily moved from place to place and is used to salvage rusty cans.—*By C W Geiger*

For cleaning the outsides of cans

A New Departure for the Mired Car

EVER since the first self propelled vehicle got its driving wheels mired in a mudhole of sufficient proportions to cause them to spin in the ineffectual attempt to get traction, tradition has had it that the way to extricate the automobile from such a predicament without the aid of horses is to pass a rope from the rear axle to a tree or stake and make the car draw itself out of the soft spot by winding this rope up on the axle But in the words of Albert H Geddes of Brooklyn, "many objections and disadvantages to such a method have been noted, principally the necessity of carrying a multiplicity of tools for the purpose" So Mr Geddes has invented a scheme which is otherwise

The fundamental principle of using the rear axle as a drum about which to wind a cable Mr Geddes retains. But his departure consists in fixing the other end of the cable not to a tree or a stake, but to the front wheels! When the stalled car is cleared for action the cable is wound about a drum fixed to one of the front hubs. The other end is hooked on to a similar drum at the rear, the engine started, and the clutch engaged The rear wheels spin, winding the cable about the rear drum—and unwinding it from the front drum The only thing the front wheels can do, under the circumstances, is to revolve and act as temporary driving wheels. According to circumstances, the rope can be wound about both drums in the same direction or in opposite directions, so that the first speed forward—the greatest developer of power which the average car possesses—may in every case be used to run the car out of its difficulties.

One other detail is necessary to make the device operative. If the front wheels were free to turn on the steering-knuckle spindles, the action of the differential would probably be to pull upon the two front wheels with a sufficiently different pull to twist them about This is prevented by a simple means for bolting the steering knuckle arms to the front axle adjacent to them. The car then has no discretion save to move straight forward or straight back, as the case may be And if one length of the rope is not sufficient to extricate it, winding it about the front drums and repeating the operation is simpler than relocating a stake.

Even Pressure in Drawing Presses

IN the drawing of metal shells for dies, one of the most vital factors is to obtain an even, unvarying pressure during the entire stroke of the press. The spring cushion illustrated herewith was designed to meet this requirement. The use of ordinary coil springs or rubber bumpers is found to lead to back-lash of the press, hence these were abandoned. The even pressure spring cushions are attached to the press by means of a single belt, which screws into the bolster plate or into the die itself, in the same manner as rubber bumpers or coil springs are fastened.

During one entire revolution of the crankshaft the punch is descending on the blank, previously centered on the

The spring cushion which gives uniform pressure in the drawing press

drawing ring forming the shell over the center-block The die-pins resting on the pin plate (which in turn rests on the spring housing) force the spring housing down, compressing the spring against the spring washer The spring washer is carried by the lower ends of the equalizing levers. When the spring housing descends, it carries with it the adjusting screws, and these allow the equalizing cam to descend by yielding to the pressure of the rollers at their upper ends. The angle of the equalizing cam together with the change in leverage of the equalizing levers compensates for the increase in spring pressure created by compression, hence we get the even pressure sought.

The Kindling-Wood Machine

OUR German correspondent puts in our hands the accompanying photograph, accompanied by a note to the effect that it is a Neuartige Brennholzerkleinerungsmaschinen In plain English this is nothing more formidable, literally translated, than a new-sorty fire-wood-smalling machine; only in German when they create effects of this sort it is not customary to soften the shock by the use of hyphens. The curious machine which is portrayed is intended for the production of kindling wood of a decidedly small caliber and its use is preceded by that of a circular saw of the familiar sort, but smaller than one would ordinarily find at work on a commercial scale The wood is fed into this saw in such a way that it is cut into strips quartered across the grain Small bundles of these strips are then held, by hand on each of the cutting tables of the machine which we illustrate, and which requires for this purpose two operators. The huge head, carrying its two hatchet blades, swings up and down on alternate sides like the walking beam of the old fashioned ferry-boat, and it cuts small bits off the ends of the strips which are fed to it Obviously it will work much faster than a hand-hatchet, but we should imagine that there might be some doubt whether it would work sufficiently faster than two hand hatchets to pay for its initial cost and operation. However, that is another story, the machine itself is certainly a curious and interesting specimen

A German machine for chopping kindling wood

An Efficient Spring Oiler

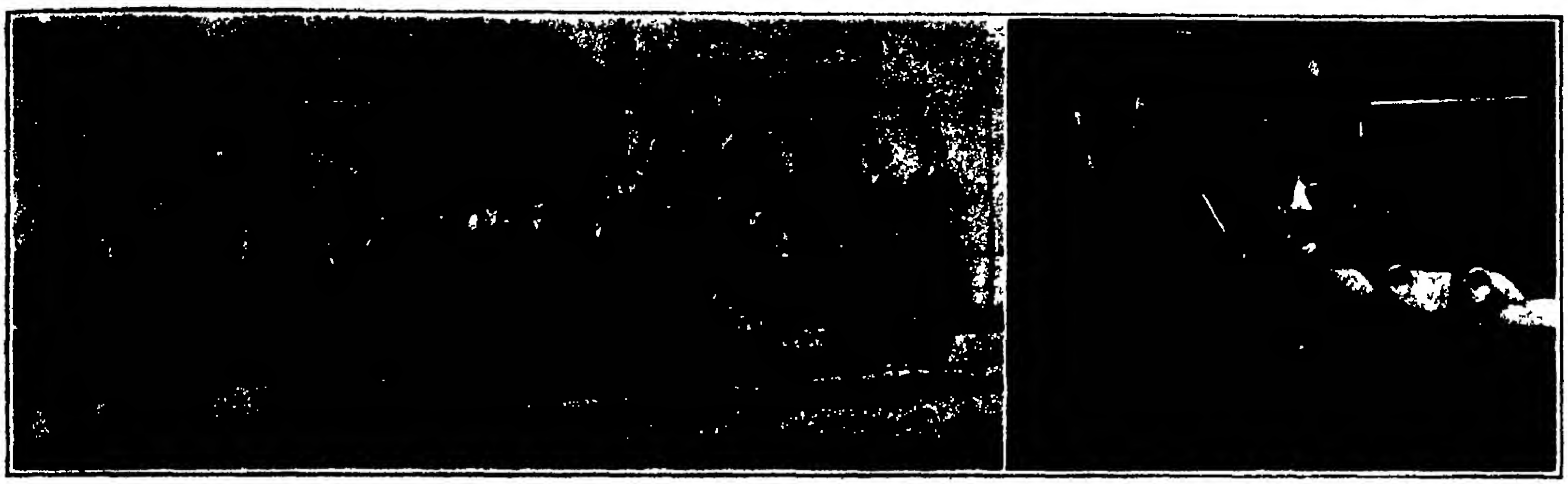
A SIMPLE and convenient means of keeping the springs of the motor car lubricated is to fasten to the end of each spring this device. The attachment consists of a woolly substance (thoroughly saturated with oil) set upon a hinge-like base The working of the leaves releases the oil, and there is practically a constant flow as a result from this efficient little worker.

Keep the wool sponge oily, and it will keep the springs oiled

The Motor-Driven Commercial Vehicle

Conducted by MAJOR VICTOR W PAGE, M S. A. E.

This department is devoted to the interests of present and prospective owners of motor trucks and delivery wagons The editor will endeavor to answer any question relating to mechanical features, operation and management of commercial motor vehicles



The old and the new: representative horse-drawn and motor-driven fire-fighting apparatus

Motor Truck vs. Horses in Fire Fighting

WHEN firemen led Dobbin and Dollie from their stalls to make room for motorized fire-fighting equipment city life lost one of its greatest thrills. Since that eventful day, many a small boy and not a few of his elders have missed the sight of the plunging horses and swaying drivers. No doubt, too, they have wondered as they watched the giant pneumatic-tired fire trucks speeding along whether it was necessary to forfeit forever the sentiment and human interest with which the horse-drawn engines, ladder trucks and hose carts were always surrounded That the change has been a sensible one, however, has been proved over and over again in the fire departments of our leading cities. The 40 per cent increase in efficiency, due to the adoption of motorized equipment as reported by the Chicago Department may be taken as a representative figure Whether it is a question of property loss or the loss of human life, motorization has quickly proved its case

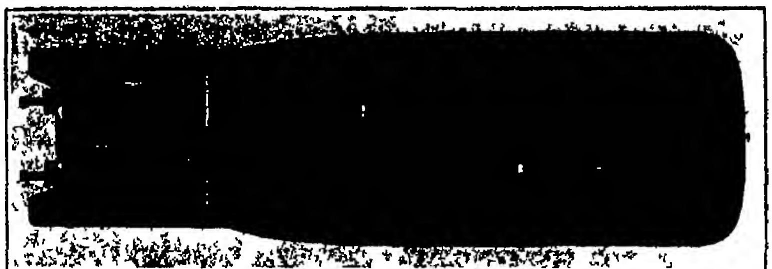
Detroit has experienced the same results as those which have been reported by Chicago, New York and other cities. In fact, it was in Detroit that the first piece of motorized apparatus was placed in service. As the first exponent of modern fire fighting, this equipment was installed in Engine Company No 30 in 1908. This original equipment is still in service, but, of course has been supplemented by many additional units. Today's figures show that in Detroit there are only seven engine units operating on a horse-drawn basis.

Since the purchase of the first unit, then looked upon as a doubtful experiment at best, motorized fire-fighting equipment has justified itself many times over in time, property and human life that it has saved. It operates so quickly that the all-important time element, which is the essence of fire fighting, is conserved to the utmost. Detroit departmental records cite one case where a run of 15 city blocks was made in a minute and twenty-seven seconds from the sounding of the alarm. Such performance was unthought of in the day of horse-drawn equipment, and makes possible untold savings in life and property, due to the fact that many fires are checked in the incipient stage Further than this, motorization enables the firemen, once they have arrived at the scene of the blaze, to get into action very quickly Especially is this true in the case of the motor-driven pumping units which have replaced the horse-drawn engines. With the motor-driven units it is possible to get up sufficient water pressure instantaneously

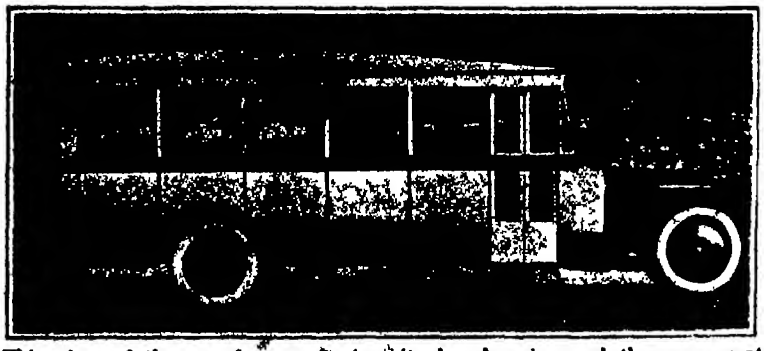
The practical value of this increased efficiency, of which the motor-driven pumping unit is but one example, is illustrated by figures which show the percentage of loss, compared to the value of property affected, in Detroit from 1915 to 1920 A reduction of one-third was made in this period, the percentage having been 9 in 1915 and 6 in 1920

Another phase of fire fighting in which motorization plays an important part is fire prevention work. The 35,000 inspections which were made in Detroit during 1921, to discover and correct fire hazards, would have been absolutely impossible without the aid of a highly mobile and efficient motor squad When it is borne in mind that in 1921 Detroit suffered from 508 less fires than it did in 1920 and reduced its fire loss more than $1,000,000, the value of such a service will be readily appreciated. And not only does the use of motor equipment operate to the advantage of the Fire Prevention Bureau, but it assists immeasurably in the work of other bodies

From the taxpayer's standpoint, motorization has proved a genuine economy Although the personal comfort and welfare of the firemen have been greatly improved, the operating expenses are much less than they were in the horse-drawn régime The horse was an item of expense 24 hours a day Feed bedding and veterinary attention and many other necessities figured largely in the annual appropriation Through the adoption of motorized methods all of these expenses have been reduced merely to a matter of gasoline, oil and tires



Plan of the truck designed for bus service, showing seating arrangements



This view of the new bus emphasizes its low hanging and the consequent stability and convenience

New Model Designed Solely for Bus Service

A SPECIAL type of motor bus having new features of design which are important in passenger transportation but not available in the conventional types of motor truck chassis, has been brought out by a well known motor truck manufacturer of Cleveland The new design is one of the first in which both chassis and body have been developed especially for bus work It gives railway companies and bus companies the advantage of using equipment that exactly fits the needs of bus operation.

The new model which is illustrated herewith has a wheelbase of 198 inches, making it possible to mount without excessive overhang a body which has comfortable seats for 25 passengers. Long and flexible springs, a low center of gravity and the long wheelbase combine to make riding easy Because of its low loading height only one step is needed at the entrance Passengers can enter or leave rapidly so that stops are short and fast schedules can be maintained Two types of bodies have been designed for the bus chassis—one known as a city type and the other an interurban type Operating companies, however may use other types of bodies when desired. The city type permits of great freedom of movement about the interior and eliminates "choking" at the entrance The interurban type is designed for the utmost comfort of passengers on long trips with ample space for luggage Both types have wide double doors at the front and an emergency door in the rear

Standard equipment includes generator and electric lights, side braces on the frame steel wheels and solid tires, single in front and dual in rear The tire equipment is especially adapted to operation on city streets. Pneumatic tires and disk steel wheels can be furnished, if desired for interurban operation. This tire equipment does not raise the low center of gravity nor increase the frame height The use of various optional standard gear ratios makes possible a wide range of speed and acceleration In the manufacture of the bus chassis the well-established and experienced company has endeavored to give it the highest possible earning capacity

Sir Ernest Shackleton

WHILE his ship the "Quest," was lying at anchor off South Georgia Island, lonely outpost of the Falkland Island colonial administration Sir Ernest Shackleton, the Antarctic explorer died of heart disease on January 5th The news of his death reached the civilized world only on the 29th of the month, with the arrival at Montevideo, Uruguay, of the Norwegian tramp, "Professor Gruvel" bearing the body Sir Ernest died of heart disease which, so far as we know, had never been observed to be constitutional with him He had been slightly under the weather on retiring the previous evening, but nothing was thought of this. At 3 30 A. M., however, he underwent a sudden collapse, and died within three minutes.

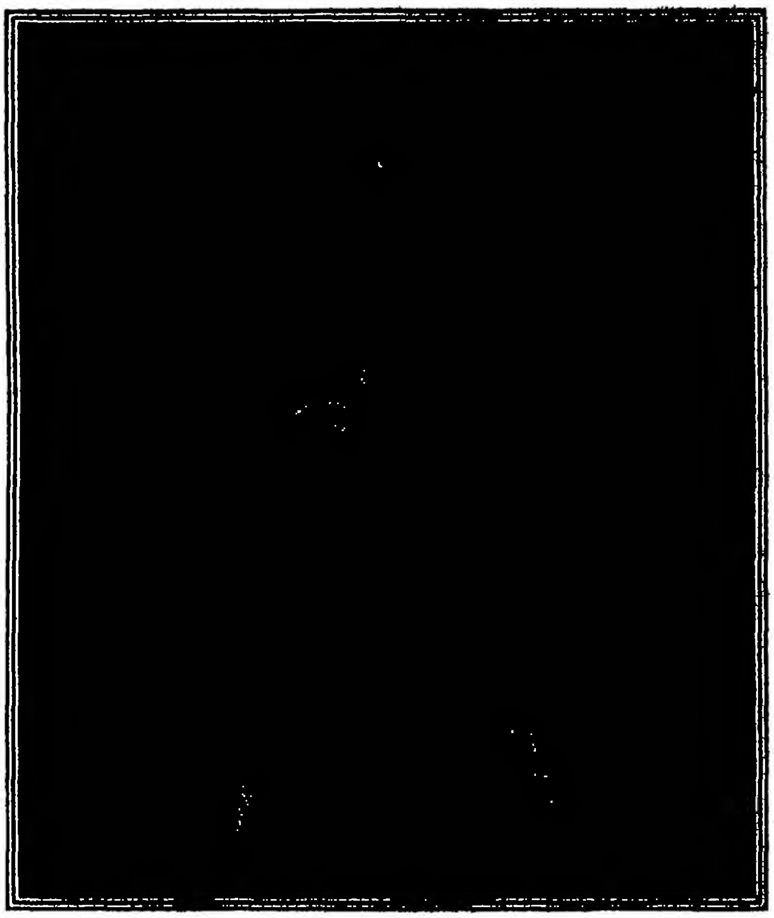
Shackleton was born on February 15th, 1874, at Kilkee, in the south of Ireland. He was the eldest son of the local physician He was educated at Dulwich College and then entered the merchant marine In 1901 he was third lieutenant of the National Antarctic Expedition, under the late Captain Scott The interest in such work which was aroused at this time remained with him for the rest of his life and supplied the driving influence for most of his later activities. He first became prominent in the field of Antarctic exploration when he commanded the British Expedition of 1907-09 On this trip Shackleton attained the farthest south record of 88° 23', only 97 miles from the pole—a mark which was surpassed only when Scott and Amundsen later reached the pole itself The expedition of 1907-09 was perhaps the first of the south pole explorations which brought back scientific results of large value In addition to the relocation of the south magnetic pole, the party collected meteorological, biological and zoological data of real consequence, and made as well notable additions to the technique of polar exploration itself

Shackleton's most dramatic voyage was the one of 1914-16. The program here was to cross the south polar continent from sea to sea. Although this idea was not put into successful execution, and although the expedition brought back scientific results of relatively small value, the enterprise turned out to be by all means the most adventurous onslaught ever made by man upon the polar regions at either end of the earth The ship, the "Endurance," entered the ice near South Georgia in December, 1914, and a year later was crushed at a point to the east of Graham Land From this date, November 24th, 1915, until April 9th, 1916, the party drifted with the ice floes. On April 9th, 1916, they encountered for the first time sufficient clear water to justify the launching of their boats. Six days later they landed on Elephant Island, 300 miles from South Georgia Shackleton and five of his men presently set out in a 20-foot open boat through snow, high winds and heavy seas. This sortie was successful, an inlet on the wrong side of South Georgia being made in safety on May 16th With the two men who remained in best condition for the trying trip, the commander then set out through the interior of this desolate island, mountainous and glacier-covered, and reached the whaling station in Stromness Bay, on the north side of the island, from which the "Endurance" had sailed in 1914 Shackleton must have presented a good deal of an apparition to those in charge of the station, and the extraordinary character of the whole incident was in no wise abated by his first question—a demand to know when the war had ended!

After sailing around and picking up the other members of the emergency expedition, it was next in order to undertake the rescue of the 22 men left behind on Elephant Island After three failures, he finally got to them and brought them off in a Chilean tug. It then developed that there was more rescuing to be performed The "Aurora," which had been sent around to the New Zealand side of the antarctic continent to await Shackleton's arrival and to pick him up, had been driven off to sea while ten of her men were on the ice, and had been so badly crippled that it was with difficulty her navigator was able to make a New Zealand port Characteristically enough, nobody seems to have worried much about the ten marooned men until Shackleton himself got wind of their plight. Three of them, it turned out, had died, but the surviving seven Shackleton brought off to New Zealand.

It might have been thought that this experience, coupled with that following his 1907-09 expedition, would have been enough. In 1910, it will be recalled, after the British Government had repudiated the costs of the 1908-09 journey, Shackleton met as much of them as he could from his own resources, and then undertook a lecture tour of this country to raise the balance so that he might reimburse his friends who had advanced the funds to make the expedition possible. But neither this nor his adventurous time of 1914-16 damped his ardor, and in September, 1921, he left England on what was destined to be his last exploration. He was to be gone two years, and cover some 30,000 linear miles of uncharted waters in the Antarctic region. After damage incurred from rough water off Portugal, the "Quest" laid up in Rio de Janeiro for repairs, and it was from this port on December 18th that Shackleton made his final departure from civilization in the little 200-ton craft

It was his human side that made Sir Ernest Shackleton such an interesting personality He was a man of fine impulses, of great fearlessness and of unlimited enthusiasm for his work He was modest in the estimate of his own accomplishments, always fair in awarding full justice to his subordinates, and more than generous in his recognition of the achievements of other explorers.



Sir Ernest Shackleton

German Scientific Books

DESPITE the severe conditions which we must believe the depreciation of the mark to have brought about in German industry, especially of the less essential sorts, the German publishers are beginning to get into their stride again after the long hiatus of actual war times. Within the past few weeks we have received from a single publisher, W Engelman of Leipsig, copies of a number of volumes that indicate this. None of them is a new production from the point of view of authorship, but all are new editions, and in some cases it is clear that the entire volume is from new type.

Perhaps the most interesting of these items is a sixth edition of Newcomb's *Popular Astronomy*, which carries the name of Dr Ludendorff on the title page as responsible for the German form of this edition. The text, tabular matter and illustrations are well up to the high mechanical character of German prewar scientific books.

Another old friend whose tenure of life has been restored by a new printing is Kowalewski, *Die Klassischen Probleme der Analysis des Unendlichen*. In the new edition as in the old we have an admirable example of the ability of the German typographer to deal elegantly with complicated mathematical notation. No mathematical library may be considered complete without this work.

For some time it has been the unfortunate case that trigonometric and logarithmic tables of more than four or five places have been either altogether out of print, or obtainable only at exorbitant prices. It is therefore a pleasure to chronicle a reprinting, apparently from the old plates, of Peters excellent seven-place tables, and likewise of the eight-place tables in two volumes that bear the names of Bauschinger and Peters. The former gives trigonometric functions (in the logarithmic form) only, the latter gives as well the logarithms of numbers up to 200,000. In both volumes the trigonometric tables are presented for every second of arc.

There appears to be just one drawback in regard to these volumes and others like them. When they were prepared, a little printed card was got up to accompany them abroad, explaining that owing to the exchange situation a premium of 50 per cent over the quoted prices would be required of all overseas purchasers. Before they were sent out it was found necessary to alter this figure by rubber stamp to 100 per cent; and in the case of those most recently received, the "Valuta Aufschlag" has gone up to 200 per cent. We have had several experiences of late which demonstrate that the surcharge which the canny German tries to make for the doubtful privilege of doing business in his utterly worthless currency customarily multiplies itself by two or three during the interval between his quotation of a price and his customer's acceptance. We don't know just how one can do business on this basis, save by keeping constantly in mind that the quoted price in marks is so low (not more than 150 marks for any of the above volumes, fairly well bound) that if one really wants them one can afford to pay pretty nearly any fine which the publisher may seek to impose upon him for the privilege of purchasing them.

George Baldwin Selden

THE last echo of a *cause celebré* was heard when the daily press of January 17th chronicled the death in Rochester, N. Y., of the Selden patentee. Mr. Selden will be remembered as the inventor who collected royalty for many years from the bigger half of the American automobile industry on a patent which claimed the aggregation of engine, clutch, fuel tank, carriage, etc., into an automobile; but which really did not cover the modern gasoline automobile at all. He had filed his application in 1879, and by exhausting every artifice permitted under Patent Office procedure, had kept it "pending" until he was obliged in 1895 to accept its issue. Only when the patent was within a few months of expiration was his prosecution of unlicensed makers finally thrown out of court.

Mr Selden had believed in the future of the automobile, and had planned to capitalize that future by means of his patent. But he had regarded the constant-pressure, slow-burning Brayton engine, not really an explosion engine at all, as the ultimate type, and had specified it more or less explicitly in his claim. One is led to wonder whether he was not in ignorance of the existence of the Otto engine; for it seems that it would have been easy to broaden his claims to include any gas engine using liquid fuel. In any event, the automobile was developed commercially using the Otto explosion engine; so that the Court was ultimately able to decide that the Selden patent, while valid in itself, was not infringed by any of the defendants against whom suit had been brought under it. We may infer that the Court reached this decision with a certain degree of satisfaction, for Justice Hough in the opinion stated: "No litigation resembling this case has been shown to the Court, and no instance is known to us of an idea being buried in the Patent Office while the world caught up to and passed it, to be then exhumed in a patent useful for tribute only."

Throughout the long litigation under the Selden patent, the SCIENTIFIC AMERICAN had maintained this viewpoint, and had been outspoken in its condemnation, on legal, technological and moral grounds alike, of the patent and the effort to levy upon the industry through it.

The Service of the Chemist

A Department Devoted to Progress and Achievement in the Field of Applied Chemistry

Conducted by ISMAR GINSBERG, Chemical Engineer

Many Uses for Little-Known Mineral, Bentonite

ACCORDING to a report made by R. B. Ladoo of the Bureau of Mines, the little-known mineral, bentonite, possesses certain unusual chemical and physical properties which makes it useful in a large number of ways in industry. The name itself is not descriptive of a single mineral, but of a group of clay-like materials which contain an alkaline oxide and an alkaline earth content of 5 to 10 per cent. The grain size is fine, the minerals possess high absorptive powers and are colloidal in nature. The physical and chemical properties vary quite widely as there is no fixed composition of the mineral.

Up to very recently the uses of bentonite were very limited and of comparatively slight importance. It was used largely in the manufacture of the medical dressing known as antiphlogistine, in the manufacture of a packing and dressing for horses' hoofs, as retarder in the manufacture of gypsum wall plaster, as a filler in the manufacture of paper and soap, and as an adulterant in the preparation of drugs and candles. However, the peculiar properties of the material have stimulated investigations to develop new applications for it, and lately careful study has been made of this material, with the result that a whole series of new uses for the same has been evolved.

In the manufacture of soap it has been found that certain of the bentonites can replace as much as 25 to 50 per cent of the soap substance and still give a product that is as good as ordinary soap in every respect. Other members of this class of minerals have been known to make very effective adhesives, especially a paste with which paper can be made to adhere to metal. The claim is that labels pasted on metal with a bentonite glue will not curl up and drop off. The fact that bentonite has such a great absorptive power for water has suggested a possible use in the dehydration of crude petroleum and other oils. Other uses that may be mentioned are: as a base for massage creams, a base for the manufacture of lake colors, for printers' ink, as a heavy lubricant or grease when mixed with oil, and as a filler or dressing for leather.

New Uses for Sulfocyanates

THE sulfocyanates are recovered in the manufacture of gas. The cyanogen compounds in the gas are removed therefrom by passing the latter through purifying media, usually iron oxide, and the sulfocyanates result from a combination of the sulfur with the cyanogen and the iron of the purifying mass. Most of the attention paid by gas plants to this product in recent years has been along lines of getting rid of it by conversion into ferrocyanides rather than in the way of constructive development of new uses.

H. E. Williams in the *Journal of the Society of Chemical Industry*, 1921, pages 221 to 224, calls attention to the fact that sulfocyanates can be used to good advantage in the manufacture of parchment paper, "vulcanized fiber" from cellulose, of mercerized cotton, and in filament spinning. The parchment paper is made by dipping the paper in a solution of calcium sulfocyanate and calcium chloride at the boiling point. A very strong parchment paper is obtained in this way. The vulcanized fiber is made from the parchmentized paper by retreating the same in a second bath of calcium sulfocyanate. The paper is then pressed between rollers. A product is obtained in this manner that resembles vegetable ivory very closely. It can be sawed, turned on a lathe, perforated and machined in any way. It will also take a high polish.

Paper from Oat Hulls

ACCORDING to S. D. Wells in the *Paper Trade Journal*, oat hulls can be used to good advantage in the manufacture of paper pulp and strawboard. The oat hulls are digested with lime. The cost of the product should not be higher than that in the manufacture of pasteboard from straw. The strength of the oat hull product is not as great as that of the straw product, but by admixture of the two raw materials a very tough paper may be obtained. In making pulp from the oat hulls, the latter are mixed with cotton linters or cotton hull fiber and treated according to the sulfate process. The high yields that are obtained and the good quality of the product indicate a promising source of pulp for the manufacture of paper used for printing books, magazines, for writing purposes, etc.

Compression of Zinc and Zinc Alloys

EXPERIMENTS have been made recently in Germany with the view of increasing the strength of zinc and brasses by subjecting the metals to compression. In one case zinc containing about 1 per cent lead with traces of iron and cadmium was so improved by the compressive process that the product appeared to be almost a new metal. Because of the non-uniformity of the results obtained thus far, the process has not received any considerable application.

Nitrated Coal, a New Raw Material for Paints and Varnishes

WHEN finely ground, air-dried lignite coal, containing about 25 per cent of water, is gradually introduced into a mixture of nitric and sulfuric acids, five times the weight of the coal, and consisting of 7.5 parts of concentrated H_2SO_4 and five parts of HNO_3 (specific gravity 1.42), there is obtained a product which is a nitrated derivative of the original coal. The nitration is conducted at the ordinary temperature, and the coal is permitted to remain in contact with the acid for about an hour. At the end of this time, the mixture is poured into water, the precipitate is sucked off and washed with water. The nitrated product is reddish brown in color, somewhat lighter than the original coal, and contains 3.8 per cent of nitrogen. It is soluble almost completely in acetone, pyridine, dichlorhydrin, as well as in a mixture of benzol and alcohol. The yield is almost 100 per cent.

The pyridine solution of nitrated coal can be diluted with water, without the solution becoming turbid. The solution foams just like a solution of soap, although not so strongly. It is precipitated by various mineral acids, barium chloride, silver nitrate and other salts. The salt, obtained when the solution is precipitated with calcium salts, contains 6.3 per cent CaO. The nitrated coal is colored a brownish black with alcoholic potash solution, if the caustic solution is poured off and the residue is taken up with water, then there is obtained a deep black solution, which behaves towards acids and salts just like the pyridine water solution. The solutions of nitrocoal in acetone or benzol alcohol leave behind on evaporation a lacquer like film. This makes it possible to use the product in the paint and varnish industries.

New Nitrate Lands in Chile

ACCORDING to the Commerce Reports, it is claimed that a new deposit of nitrate of soda over a district of 2000 square kilometers has been discovered in Chile. No soda was known to exist in this region heretofore. The deposits lie 11 feet under the surface and the beds contain 20 to 40 per cent of nitrate.

A Chemically Controlled Automobile

THE production of power in an automobile engine is not a simple affair, as may be supposed, but depends on a complex chemical reaction. To get the most miles out of a gallon of gasoline is equally the aim of the owner of the high priced car as well as of the lowly Ford. Realizing the nature of the process which converts the liquid gasoline into mechanical power, there remains but one way in which the maximum efficiency can be obtained from the fuel and that is by chemical control. G. G. Brown in the *Journal of Industrial and Engineering Chemistry*, 1922, 6, gives the results of his very interesting and enlightening experiments on the operation of the automobile engine under chemical control.

The important thing is to secure the proper mixture under all conditions of operation. Very careful tests revealed the fact that the maximum efficiency is obtained with a hot dilute mixture. The colder the engine, the more concentrated the mixture must be in order to maintain the velocity of reaction above the critical point necessary for explosion. A special form of carburetor is described, which is controlled automatically and according to chemical principles—that is, to give the proper mixture of air and gasoline under all conditions in the engine, so as to obtain the maximum mileage from a gallon of gasoline.

The exercise of chemical control to obtain complete combustion of the gasoline and hence maximum power resulted in increases from 25 to 100 per cent in the mileage per gallon. The Ford car, which will average about 19 miles to the gallon ordinarily, will give 30 miles to the gallon with chemical control. A heavy car of eight or more cylinders, giving 8 miles to the gallon under ordinary circumstances, will run 18 miles to the gallon with chemical control.

New Leather Grease

ACCORDING to the *Chemische Umschau*, 1921, 244, a new leather grease, which may also be applied to chrome tanned leather under certain conditions, and which is considerably cheaper than the animal fats used up to the present time, is made from mineral oils. The oil is mixed with a calcium soap which overcomes the disadvantage of the same, causing the leather to become hard and brittle. Neutral fats or fatty acids are also added in order to make the mixture emulsifiable with water and hence applicable to wet leathers. The process consists in heating the mixture of fatty acids and mineral oils to 110 degrees C. and then stirring in the calculated quantity of calcium hydroxide gradually. The mixture is allowed to stand, when transferred to a mixing pan, warm water is added and the whole is stirred until cold. A sample analysis of such a product is 8 per cent of calcium soap, 8 per cent of neutral fat, 64 per cent of mineral oil and 20 per cent of water.

Nitric Acid Made with Ozone

A PATENT has just been issued (see United States Patent No. 1,400,912) on a novel process of making nitric acid by the oxidation of ammonia with the aid of ozonized air. The ammonia itself is produced by the treatment of cyanamide with steam and it is claimed that the ammonia in this nascent state can be oxidized very readily to nitric acid with a comparatively small production of nitrous oxides. The apparatus used in the process consists of a spherical receptacle provided with a cover which can be secured to it very tightly by means of bolts. The whole apparatus resembles an autoclave very much. In about the center of the apparatus there is a circular perforated diaphragm on which the cyanamide is placed. After the cover has been bolted into place, steam is added through an opening in the cover and the cyanamide is decomposed with the formation of ammonia, which passes through the diaphragm into the lower half of the apparatus. Ozone is then admitted through the bottom and mixes with the ammonia, oxidizing it to nitric acid which is discharged through a bottom outlet. The process is very interesting, for it gives practically all nitric acid and avoids the use of towers and other oxidizing apparatus to convert the nitrous oxides, ordinarily obtained in the ammonia oxidation process into nitric acid.

New Oil-Hardening Process

AS is known, the hardening of oils, which in other words is also called the hydrogenation of oils, consists in treating the oil with hydrogen gas, whereupon the oil absorbs the gas and the former is converted into a solid fat. To assist in the process, catalysts are used, substances which cause the action to take place more quickly and with better efficiency than when they are absent, and which in themselves suffer no change during the treatment. According to the Italian journal, *Giornale di Chimica*, October, 1921, a new catalyst has been found, which is the double silicate of magnesium and nickel, and which it is claimed gives very remarkable results. One of the great improvements worked by the new catalyst is the production of absolutely white solid fats from dark colored oils, which in the former methods of hydrogenation have to be purified first before conversion into a fat.

Increasing the Flash Point of Cylinder Oils

ACCORDING to the *Seifensieder Zeitung*, a very effective method of raising the flash point of cylinder oils is to add to them from 3 to 15 per cent of the aluminum salt of fatty acids.

The Heavens in April, 1922

The Observations on Venus' Atmosphere, and Some Plausible Deductions That May Be Drawn Therefrom

By Prof Henry Norris Russell, Ph.D.

IT has been known for a century and more that Venus has an atmosphere Indubitable evidence of this is afforded by observations made when she is nearly but not quite, in line between us and the sun She then appears, of course as a very narrow crescent, but is so bright that she is conspicuous in even a small telescope When the sky is clear it may then be noticed that the thin horns of the crescent extend considerably beyond the half-circle that marks the limit which they can attain on such a body as the moon Under favorable conditions, when Venus is very close to the sun in the sky, the crescent may extend over three-quarters of the circle, or may even close up, so that the planet appears as a luminous ring Such a phenomenon can be produced only by an atmosphere surrounding the planet Looking past the planet's edge we see the illuminated atmosphere—sometimes all around the dark edge of the disk

Though it is thus made certain that Venus has a gaseous envelope, this must be much less extensive than the earth's—for the part of it which, when lit up by the sun, is bright enough to be seen through the illuminated foreground of our own daylight sky extends for only about 00 miles over the night side of the planet, and has a depth of less than one mile The earth seen through a similar sky in a like position would show far more conspicuous effects of twilight, and a much greater prolongation of the horns of its crescent, so we may conclude that there is much less atmosphere above the *visible surface* of Venus than over the earth *The proviso is necessary, for it is* possible that Venus' surface, which is very white, is composed of clouds, and there may then be any amount more of atmosphere below these

If we seek information regarding the composition of this atmosphere, we must employ the spectroscope As everyone knows, some of the gases of our own atmosphere—oxygen and water vapor—absorb light of certain wave lengths and give rise to dark lines in the spectrum These atmospheric lines can be observed in the spectrum of a terrestrial light-source a mile or two away, and they are conspicuous in that of the sun growing stronger as the sun sinks toward setting and its rays traverse a longer path in the air The water vapor lines, moreover change greatly with the weather, being faint on cold, dry days and strong on hot, damp ones, when the air is steamy

Now if we could live and observe on the moon, which has no atmosphere, we would not find these lines in the spectrum of the sun, but the light reflected from the earth, having passed twice through our atmosphere, would show them strongly We could thus be sure that these constituents were present in the earth's atmosphere—and, of course, we could apply the same test to all the other planets from which we could get sufficient light to work As we are we must observe from the earth's surface through our own atmosphere, so the absorption lines which are there produced we find in *the spectra of all celestial* objects. If a planet has an atmosphere, too, containing oxygen, we will get the combined effects of its atmosphere and our own If the planet's atmosphere contains more oxygen than ours, the resulting lines will be heavy and we can detect this oxygen by comparison with the spectrum of the moon, where only our own atmosphere is effective But if the planet's atmosphere is poor in oxygen, the terrestrial effect will drown out the feebler planetary one.

To separate the two, St. John has now used an ingenious method, previously employed by Campbell With a powerful spectroscope of very high dispersion he has photographed the spectrum of Venus when near elongation, and rapidly approaching or receding from the earth At such a time the lines in the planet's spectrum (whether produced in its own atmosphere or previously present in the sunlight itself) will be shifted to the violet or the red in accordance with the well-known principle of Doppler The lines absorbed in the earth's atmosphere will, of course undergo no shift. By choosing our time, and using a powerful spectroscope, we may get the two sets of lines—planetary and terrestrial—fairly well separated, so that if there were absorption in both atmospheres, each line of oxygen (for example) would appear as a close double.

When the experiment was tried Dr St. John found no trace of doubling. The terrestrial lines were there as usual, but not even a *suspicion* of those which should be produced by oxygen in the atmosphere of Venus, although it was known exactly where they ought to appear The water vapor lines yielded precisely the same result, and repeated photographs, on different days confirmed the conclusions.

There can be no doubt, therefore, that the atmosphere of Venus is devoid of water vapor, and of oxygen, too By comparison with laboratory experiments on the absorption in our atmosphere, St. John concludes that the amount of oxygen above Venus' surface cannot exceed *the thousandth part of that in the earth's atmosphere* For water vapor the test is less delicate, but the maximum amount upon Venus can be but a few per cent of that which is ordinarily present here.

This result—which is confirmed by observations made by Slipher in another way at the Lowell Observatory—appears at first sight very extraordinary Venus and the earth are twin planets—very similar indeed in size, *mass and density The only great difference between* them is that the whole surface of Venus is covered with some white substance, while only half that of the earth, on the average is similarly clad (with clouds) Both planets are massive enough to retain water-vapor permanently in their atmospheres. Why, then, should Venus be waterless?

The difficulty may be escaped if we adopt the assumption, *which seems reasonable in other ways*, that the visible surface of Venus is composed of a permanent layer of clouds. We know that, on earth, the temperature of the atmosphere *falls steadily* up to a height of some 10 miles, and beyond this remains nearly the same In the lower part of our atmosphere, vertical currents, ascending and descending, are continually at work The water vapor evaporated from the oceans these currents carry to higher levels, where it condenses to form clouds.

But in the upper, or "isothermal" layer, there is little or no vertical streaming—the uniformity of temperature prevents it So practically no water-vapor gets into this region the air there is dry and always cloudless. The upper boundary of the region of clouds is marked by the familiar wispy cirrus clouds, which lie so high that no man in balloon or airplane has ever looked upon their upper surfaces.

If the circulation in the atmosphere of Venus is similar, and if, as seems probable, evaporation from its oceans is more rapid *than from ours, it may well* be that its atmosphere contains a permanent layer of high cirrus clouds, at the very top of the region of vertical circulation The atmosphere above this would belong to the isothermal layer, and would contain practically no water-vapor. Whether or not this is the true situation on Venus, it seems clear that an observer on some other planet, working spectroscopically on the light reflected from the earth in a region covered with high cirrus clouds, would get much the same results, with regard to the water-vapor lines, as Dr St John got on Venus.

But such an observer would still get oxygen lines in the earth's spectrum—for the proportion of oxygen in the isothermal layer is about the same as in the lower air Moreover, this layer contains at least 10 per cent of all the oxygen in our atmosphere, and hence at least a hundred times as much as there can be upon Venus.

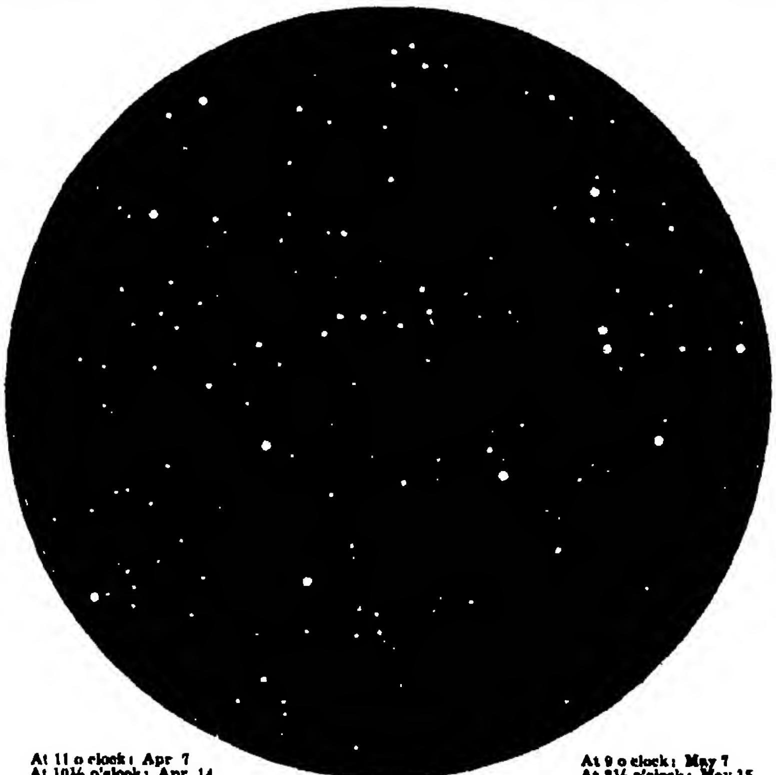
Here there seems no escape from the conclusion that the atmosphere of the planet actually contains no oxygen This *settles one question immediately and dras*tically Without oxygen in Venus' atmosphere there can be no animal life, as we know it, on her *surface, for* all animals, on land or sea, breathe oxygen, free or dissolved Moreover, there can be no vegetable life of the sort which covers the earth, for if such vegetation flourished on Venus it would gradually fill her atmosphere with oxygen Hence we conclude that Venus is a lifeless world—unless, indeed, life exists there *in forms* essentially different, in their fundamental metabolism, from those which occupy our planet Concerning such a possibility we have no basis for speculation except that afforded by pure imagination

Though we accept the conclusion that there is no life on Venus because there is *no free oxygen, the latter fact still seems* itself strange We instinctively assume that all atmospheres would contain oxygen. But is this reasonable? Free oxygen is a very active chemical agent, and is continually being used up by all sorts of natural processes, including many that are entirely inorganic The earth, as a whole, appears to be far from saturated with oxygen, the freely oxidizing materials existing beneath its surface are of such sort and in such quantities *that if* the whole globe were reduced once more to a molten mass, and well churned, we might expect the existing free oxygen to be consumed chemically.

This suggests the hypothesis—possibly bold but not unreasonable—that the free oxygen of our atmosphere is a product of terrestrial life the slow accumulation of the activity of vegetation through millions on millions of years. The oxygen may originally have been there in chemical combination. In setting it free a vast quantity of carbonaceous material must have been formed, and we must infer that this lies buried in the sedimentary rocks—as coal beds, as oil, bituminous shales, scattered portions of organic matter, and other products of chemical reduction. The total quantity necessary to account on this basis for the entire oxygen content of the atmosphere is equivalent to a layer of coal covering the earth's surface, and a little over a foot thick.

It is therefore possible that our terrestrial oxygen is itself the great evidence that life exists on our planet. The familiar oxygen bands in the spectrum then take on a new and deeper significance. Descried from afar with the aid of the spectroscope, they are the sign and signal, legible to the far-off planets should any of these be able to read it, and telling "Here is Life."

The usual schedule of the planets will be found on a later page



At 11 o'clock: Apr 7
At 10½ o'clock: Apr 14
At 10 o'clock: Apr 22

At 9½ o'clock: April 30

At 9 o'clock: May 7
At 8½ o'clock: May 15.
At 8 o'clock May 22.

The hours given are in Eastern Standard Time. When local summer time is in effect, they must be made one hour later: 12 o'clock on April 7 etc.

NIGHT SKY: APRIL AND MAY

Our Readers' Point of View

The editors are not responsible for statements made in the correspondence column. Anonymous communications cannot be considered, but the names of correspondents will be withheld when so desired

How to Keep a Car in Running Order

To the Editor of the SCIENTIFIC AMERICAN:

We have read with great interest the article on page 39 of the November issue of SCIENTIFIC AMERICAN entitled, "Some Simple Pointers on How to Keep a Car."

We wish to call your attention to the fifth paragraph in which the statement is made that "oil should be drained from the crankcase once in three months and new oil applied." We feel that *you should check up statements of this kind*, as they are apt to be a little misleading. It is the opinion of our automotive engineers, and it is also the policy of our company to recommend the draining of automobile-engine crankcases at regular intervals.

Periodic draining of the crankcase is necessary for several reasons. In the first place, it is only by draining that we can free the lubricating system of the accumulation of grit, metallic sediment and carbon which tends to build up as the oil is used over and over again.

The circulation of this non-lubricating, and sometimes abrasive, material is harmful and should be guarded against.

Likewise, there is always a tendency for the oil in the reservoir to become diluted with fuel. This fault is especially prevalent during winter operation where the carburetor choke is used excessively or where, in order to obtain easy starting, the carburetor is adjusted for an over-rich mixture.

A frequent cause of excessive dilution and one which, unhappily, is often overlooked even by the most competent repairmen, is *choking of the exhaust gas passages through the manifold hot spot. Such choking stints the supply of heat to the manifold, heat which is essential to insure thorough vaporization of our present-day fuels.*

The presence of fuel in the oil naturally reduces its body and consequently impairs its lubricating value.

It has, however, another and an even more serious effect. It greatly reduces the clinging and sticking properties of the lubricant.

Oil which is badly diluted, therefore, instead of clinging to and protecting the bright metallic surfaces within the crank chamber against rust and corrosion, drains off quickly and leaves these surfaces exposed to the precipitation of moisture and the rapid accumulation of rust which is, of course, a mighty serious factor in promoting wear.

Chiefly affected by this corrosion are the cams, cam followers, and the silent chains which are used for camshaft and accessory shaft drives on about 45 per cent of our present-day cars.

A further thought on the necessity for draining is the fact that however free from acid a fresh motor oil may be, all mineral oils in service acquire a certain amount of acidity, sometimes to a harmful degree.

The source or sources of the acids which are formed is not well understood, nor is the nature of the acids fully defined. *Some acidity is probably attributable to the fuel.* However, mineral oils employed in service where liquid fuel is not present, exhibit this same tendency to become slightly acidulated after hours of service.

The presence of this acid is not particularly harmful, provided the oil has not lost its clinging properties, and will coat and protect the bright surfaces. When the oil is badly diluted and drains from these surfaces, any acid present quickens the process of rusting.

Our automotive engineers recommend the following with respect to crankcase draining: On new cars, drain the oil from the crankcase and refill with fresh oil after the first 500 miles of service.

After this initial draining, drain and refill the crankcase with fresh oil after every 1000 miles of operation during summer weather. During winter operation, the crankcase should be drained regularly every 500 miles.

The new car, fresh from the shop, is likely to be somewhat clogged with metal chips and even sand from the castings, while it is almost certain that the rapid wear engendered by the first 500 miles of service will contaminate the oil with a large amount of metallic sediment. After the preliminary run-in period the rate of wear is considerably retarded.

For summer operation, therefore, with the car in service, it is sufficient to drain at 1000-mile periods. During winter operation, however, the cooler crankcase and less effective carburetion bring about more rapid dilution of the oil with fuel. This must be guarded against. Also winter operation entails greater precipitation of moisture in the cool crankcase which induces rust when the oil is so thin that it will no longer "stay put" and protect the bright surfaces. For these reasons, it is desirable to drain twice as frequently during winter as during summer.

The crankcase should be drained while the engine is warm, say, immediately after a run, so that the oil will be thoroughly agitated and will also be thinned considerably by the heat of operation. In this condition, it is best adapted to carry off the accumulation of sediment.

It is not desirable, and in some cases it is hazardous, to flush the crankcase with kerosene, this, for the reason that there are troughs and wells in most engines which cannot be drained simply by the removal of the drain plug. Kerosene trapped in these pockets remains to dilute any fresh oil added, reducing its body and more particularly reducing its ability to cling and protect the surfaces.

We are not calling your attention to this matter simply because we are advertisers in the SCIENTIFIC AMERICAN, but because this is a point of very great importance in the correct operation of an automobile. You can readily see that three months is a rather indefinite and irregular time to set for draining crankcase, because some cars might run 6000 miles in three months, while another car might not run 600 miles in three months. The only dependable way in which to assure the regularity of crankcase draining is *to put it on a mileage basis.*

Our recommendation for draining and refilling transmission and differential housings is *every 2000 miles*. This also is put on a mileage basis for the sake of regularity in supplying the correct lubricant.

It is not necessary for you to take our word in this matter. Many of the prominent automobile manufacturers make a similar recommendation, that crankcases be drained every 1000 miles and transmission and differential housings every 2000 miles.

We feel that in editing articles of this nature you will be doing a real service to motorists if you keep these points in mind.

HAROLD A. HALL.

New York.

The Edison Questionaire

To the Editor of the SCIENTIFIC AMERICAN:

Your account in the November issue of the SCIENTIFIC AMERICAN of Mr. Edison's questionaire system of picking executives is very interesting.

While the complex entity "man" is considerably more than the sum of all his parts, and does not therefore yield to analysis by any arbitrary or mechanical system whatever, Mr. Edison's scheme is certainly far superior to most that have been proposed for the purpose during the past few years. I take it from his emphasis of memory as the important quality however that even Mr. Edison doesn't realize the strongest point in favor of his plan, but has hit on a good plan by luck rather than otherwise.

The primary point in Mr. Edison's test is not memory at all, it is breadth of education, and consequently breadth of viewpoint. Memory comes only a poor second. Anyone who has any *knowledge of psychology knows that the human mind seeks for* and retains those things which interest it. A man with *a perfect supermemory might fail utterly* in Mr. Edison's test for the simple reason that he (as many people actually are) was too deeply interested in some one subject or group of subjects to read the newspapers or current literature. Yet if Mr. Edison were to give that same man a real memory test—say, to read a certain book and then tell as much as he could remember of its contents, that man might obtain a memory rating of 100.

The truth of the matter is that Mr. Edison is picking men of broad tastes and interests with possibly indifferent memories for his executives. It doesn't necessarily take a very good memory to retain facts that interest one, but it does take a catholicity of interests to be sufficiently interested to read over the ground covered by the questionaire.

And this catholicity of interests and broad education are, even more than fine memory, qualities of value in an executive. The function of an executive is *to form judgments* and to act on them. I believe that it needs no proof that the man of broad information, *even on matters totally extraneous to the matter at hand*, is far more capable of *forming sound judgments, taking all things into consideration*, than is he who knows only one thing and can therefore *see only one phase of a matter*. Broad education tends to develop the imagination, which is a very necessary factor in creative thinking and in reasoning things out to their ultimate conclusions. Memory, it is true, is important. So is self-confidence important; so also are will power and several other qualities. But the broadly educated man is far more likely to have those qualities developed and disciplined to an even balance than is he who is not broadly educated. And for the reason that college men are far more apt to have a broad education than others, they are more apt to possess the necessary qualities to become successful executives than are non-college men. There is a certain discipline, though somewhat loose, in college life that does tend to develop the mental qualities in spite of the great mistakes made in college curricula of which Mr. Edison speaks.

The dominating position which Britain has held for so long in world affairs has had for one of its principal factors the educational system of her great universities. This system (the tutorial system) gives much attention to training the mental faculties, but very little to jamming the mind with facts. The trained mind will accumulate all the facts it needs fast enough. Without that mental training a man may become a veritable seven day wonder as a technical shark, but he can never become a successful executive.

I hold no brief for things English. I have ten generations of American blood flowing in my veins. But I do hold a brief for anything that is essentially better than what America has, nor is my loyalty to America lessened thereby. And I would be very much tickled to see a system of training for executives introduced into America modeled on the English University system—classics and all. However much our colleges are in advance of our common school system for producing executives, they are still sadly lacking. Available executive timber has been falling further behind the demand for it every year. There are few industries that are not suffering and paying heavy penalty for having incompetents in executive positions. *I speak from the standpoint of one who has been* in the construction business for fifteen years or so, and who has come into contact with executives large and small in several score of businesses.

LEO G. HALL.

Downers Grove, Ill.

Energy and Work

To the Editor of the SCIENTIFIC AMERICAN:

In the September 10th issue of the SCIENTIFIC AMERICAN there is an article "The Man Testing Laboratory Where Expended Energy Is Measured," in which is described an apparatus for measuring the amount of energy expended in doing various tasks and the amount expended in doing these same tasks in different ways. It is expected in this way to discover the best ways of doing these various tasks.

This is one way of increasing a man's efficiency. Another way is *to increase a man's effective energy for doing* these tasks. Following is a statement of the way in which the problem of increasing a man's effective energy should be approached. A man's energy may be divided into three parts: the first part is that which goes toward keeping him alive and moving about whether he does any work or not. This part has to be supplied before there is any energy available for the work a man is to do. The second part goes toward overcoming the inertia of the things that a man works with or works on. This part has to be supplied before any energy can be used effectively. For instance in lifting a weight just so much energy has to be used in overcoming its inertia before there is any movement: 999 pounds of energy exerted in lifting a 1000-pound weight produces no more effect than if only 100 pounds was used. The third part is that which is over and above the energy it takes to live and what it takes to overcome the inertia of things. A very small amount of this third part produces wonderful effects. It is this part that should be particularly interesting to the manager of men who wants to know every possible means by which *it can be increased and made available.*

There are two ways in which this effective energy may be increased. *The first way is to increase the entire* amount of a man's energy by putting and keeping him in *a first class physical condition. This means he must have* plenty of good food and clothing, comfortable houses and medical attention, etc. The second way is by making a better use of the energy a man already has. Mr. Frederick W. Taylor and his associates have proved experimentally that a man should have a certain amount of rest in order to accomplish the best results in performing a piece of work. That the ratio between the time of rest and the time of being under load varies with the kind of work. Greater the load the longer the rest period should be. This law, as Mr. Taylor calls it, finds its explanation in the above. In order to make the best use of one's energy in performing a piece of work such as lifting or moving an object it is necessary to take advantage of its momentum. That is after it has once started to move to keep it moving. If it stops or its motion decreases there is the inertia of the object to overcome again; therefore an unnecessary loss of energy. By giving a man a rest we allow him to gather enough strength and energy to keep an object moving once it has been started. An unsteady motion always causes an unnecessary loss of energy. In many cases a slight increase of energy is all that would be necessary to prevent a great loss of energy by an object *stopping or falling back. This small amount of energy so* necessary in preventing a great loss of energy is supplied *by keeping a man in good physical condition and allowing* him the proper amount of rest. It is a business *proposition. It is a question of making the most efficient use of* the overhead expense, which in this case is the energy expended in merely living and the energy expended in overcoming the inertia of things.

WM. CROCKER.

Prescott, Ariz.

Recently Patented Inventions

Brief Descriptions of Newly Invented Mechanical and Electrical Devices, Tools, Farm Implements, Etc.

THE object of this department is to catalog recently patented inventions and design patents for ready reference. In view of the large number of patents covered, it is obvious that each notice must be confined to the broad essentials of the patent described and, in some instances, illustrated. The name and address of the inventor are given in every instance, to facilitate direct correspondence. Copies of the patent specification will be furnished upon receipt of 15 cents each. In a word, this is to be a meeting place for the man with an idea and the business man in search of an idea.

Pertaining to Aeronautics

AIRPLANE WITH INHERENT STABILITY.—A. G. LEIGH, address G. H. Slight and A. G. Leigh, Casilla 269, Santiago, Chile. An object of the invention is to construct an airplane which will more nearly simulate the flight of a bird. More definitely stated, the object is to so construct the wings as to make practical the use of a very much shorter body and tail than has heretofore been accomplished, the wing structure being such that the steering devices may be located entirely in or adjacent to the wings instead of at the tail.

TRUSSED HOLLOW SPAR.—J. Y. MAXWELL and J. P. SEISER, Cambridge, N. Y. The invention relates to trussed hollow bars or tubes, and more particularly to the spars of airplane wings, the object being the provision of a trussed hollow beam particularly applicable to airplane construction, although capable of use in other structures where a strong light spar capable of resisting severe bending strains is desirable.

Pertaining to Apparel

GARMENT SEAM.—W. S. FLATOW, 10 Bay 26th St., Brooklyn, N. Y. The primary object of this invention is to so construct a seam that the same may be readily ripped to provide for the disassembly of the parts which go to make up the garment. A further object is to so construct a shoulder or neck band seam of a shirt that the front members thereof may be removed, recut and again positioned to present an unworn surface at the collar band.

BABY PANTS.—R. FALTER, 856 E. 10th St., Brooklyn, N. Y. The object of the invention is to provide baby pants or diaper covers arranged to be made from a single piece of material, and to permit convenient adjustment at the waist, sides and legs to properly fit the garment to the baby's body and to compensate for increase in size due to the baby's growth. A further object is to dispense with hooks, buttons or similar protruding fastening devices, by using lacing strings.

CLASP.—S. L. GEDNEY, 33 Clinton Ave., Maplewood, N. J. This invention relates more particularly to clasps for garters and other garment supporters, an object being to provide a clasp which will operate to securely hold or engage, whether there is any tension or not, a stocking or other garment, and which will permit a quick engagement and release as occasion may require.

CORSET.—S. J. NEWMAN, 43 Oak St., New Haven, Conn. An object in view is to provide a construction at the rear of the corset wherein means are presented which will cause the corset to more exactly conform to the shape of the person wearing the same. A further object is to provide a corset in which the lower portion of rear section is so constructed as to cup when placed in position.

CLASP FOR CORSETS.—S. J. NEWMAN, 43 Oak St., New Haven, Conn. This invention has for its object to provide a special form of hook to answer the unusual requirements found in some corsets. Another object in view is to provide a hook which will not only freely receive the lacing cord, but will in a certain sense clamp the same against longitudinal movement.

Chemical Processes

PROCESS FOR THE TREATMENT OF UNDECOMPOSED FERTILIZING SUBSTANCES.—D. LO MONACO, via Depretis No. 92, Rome, Italy. This process has for its object to provide a suitable cylindrical casing for treating the incompletely decomposed fertilizers, and agitating the substances and subjecting them while being agitated to the action of halogen gases, whereby the substances are wholly decomposed and made ready for immediate use.

MANUFACTURE OF ACTIVATED PANCREATIN AND STABILIZATION OF SAME.—DORA E. NEUN, 13 Leight St., New York, N. Y. The invention relates to means for preserving the amylolytic digestive power of activated pancreatin. An object is to add a substance to the pancreatin activated with sodium chloride, which will so stabilize or preserve the amylolytic power of such a mixture that it may be taken into the human system without causing harmful results. The composition consists of approximately 7.5 to 10 per cent di-sodium phosphate, 10 to 13.5 per cent sodium chloride and the balance of pancreatin, all the ingredients being moisture-free.

Electrical Devices

ELECTRIC LIGHT ATTACHMENT FOR HAND COVERINGS.—F. HODOUS, c/o Concord Lexington Apartments, 69 So. 11th St., Minneapolis, Minn. This invention has for its object to provide an electric lighting device for hand coverings, and which is adapted to be incorporated in the structure of a glove or the like to provide an illumination wherever desired. It is adapted to produce a constant or intermittent light, furnished from a small source, the illumination requisite to carry out reading, writing, signaling or similar operations in the dark. The device is simple, durable and inexpensive to manufacture.

ELECTRIC WIRE SWIVEL COUPLING AND LOCK.—T. L. DENNIS, address Geo. F. Parker, 119 West 42d Street, New York, N. Y. This inventor has been granted two patents of a similar nature, they relate to swivel couplings for electric wires, the arrangement being such that the current will pass freely. An object is to provide a coupler which may be inserted in a pair of electric conducting wires or in a plurality of wires at any point and not disturb the continuous conduit while permitting free independent rotary movement of either section of wire. A further object is to provide means whereby the plugs or connecting pins may be easily inserted but are locked against accidental removal.

PORTABLE LAMP.—G. F. BASON, 160 Woodruff Ave., Brooklyn, N. Y. One of the objects of this invention is to provide an electric lamp which is adapted for general use and which may be secured to the back of the hand of an operator of motor vehicles to be used for signal purposes, or may also be used as a trouble light, an inside light, or parking light and to this end a suitable bracket is provided to support the lamp at various points.

PORTABLE ADJUSTABLE HOLDER FOR FLASHLIGHTS.—E. G. QUARNSTROM, 5419 Agatite Ave., Chicago, Ill. An object of the invention is to provide a holder for a flashlight that is readily portable and provided with adjustable means whereby the device can be mounted upon a hat, coat or other article of apparel of the operator, and the light from the flashlight directed as desired without its being necessary to hold the device in the hand.

FLASHLIGHT.—J. VINCE, 429 78th St., Brooklyn, N. Y. An object of the invention is to provide a conductor element so related to the shell and to the battery that it may be operated from the exterior of the shell and close the circuit and at the same time minimize the possibility of the battery "freezing" to the shell and makes provision for the ready removal of the battery and conductor strip without damage even should the battery "freeze" by long disuse.

ELECTRIC FIXTURE.—F. L. BUTLER, 7[illegible] E. 36th St., Chicago, Ill. An object of the invention is to provide in an electric fixture an insulated stem adapted to insulate a lighting fixture that depends therefrom from a fixed support without its being necessary to provide the usual insulating joint. A further object is to provide a device which is simple in construction, ornamental in appearance, effective in use, and may be readily manufactured at a small cost.

ELECTRIC HEATER.—O. P. SCOTT, c/o Scott Electric Manufacturing Co., Tacoma, Wash. The invention relates to heaters adapted for the heating of air or water, and a purpose is the provision of an electric heater of simple and substantial construction, wherein the elements comprised in the heater are exposed to facilitate the repairing thereof. It is also a purpose to provide an electric heater which consumes a minimum quantity of current.

Of Interest to Farmers

ARRANGEMENT FOR SEPARATORS WITH HANGING BOWLS.—F. MORTENSEN, Helsingfors, Finland. This invention relates to a separator of the type having a suction fan for drawing milk, and having an aperture through which cream is driven due to the separating action of centrifugal force, and characterized by having an outlet at one side of the suction fan through which milk may be driven under centrifugal force to overcome the suction action which tends to draw the milk into the suction fan.

AGRICULTURAL IMPLEMENT.—L. A. GREEN, c/o American Cotton Grader Company, Greenville, S. C. The invention has for its object to provide an implement wherein a supporting frame and rotatable mounted tool supports are made use of, together with a motor for driving the device, the supports being arranged in series and connected to the motor in such manner that they are driven in opposite directions, enabling an extremely light motor to equalize the strong propellers and regulate the speed, and wherein the cultivating mechanism cuts the soil backward to force the light frame forward.

FARM GATE LATCH.—H. H. and G. H. REMS, Thornburg, Col. This invention relates to gate latches in general and more particularly to latches for farm gates, the purpose being the provision of a gate latch of extremely simple and efficient construction which is operable to automatically latch a gate when the same is swung to closed position.

CLAMP.—H. R. MOKLER, c/o Tolma Deyo Co., Tolma, Ill. The object of the invention is to provide a device especially designed for holding objects of irregular form, to be ground or polished, such as plowshares, cultivator shovels, harrow-blades, planter knives, and the like, wherein there is provided a body member having a pair of fixed stops or abutments spaced apart and having a clamp movable between the abutments.

LAND LEVELER.—O. W. BEACH, Box 861, Turlock, Calif. Two patents have been granted to this inventor on similar subjects, they relate particularly to a machine which is adapted to be towed by a tractor or the like for leveling ground surfaces of agricultural lands, roadways, and like surfaces. The primary object is to provide a machine equipped with a scoop which is capable of assuming various scooping positions relative to the ground and dumping its load gradually over the surface to be leveled. Means are provided for automatically disconnecting the scoop from the means employed to move the same, means are also provided for carrying the loaded scoop to a distance, and effecting its unloading at a desired spot.

SUBSOILER.—J. F. BELKNAP, P. O. Box 81, Orange Cove, Calif. The invention relates to subsoilers or harrows, and has reference more particularly to a tooth or blade for such implement. A specific object is to provide a tooth for use in subsoiling or breaking up hardpan earth which will be rugged in construction, yet light in weight, and unusually durable regardless of the hardened condition of the soil surface on which it is to be used.

Of General Interest

KEY CASE HOLDER.—D. L. RATTER, 127 University Place, New York, N. Y. The object of the invention is to provide a holder which can be made and stamped from a single piece of sheet metal and bent and formed into shape ready for the application of key latches thereto in a simple and economical manner. Such extra attachments as pins, or other similar devices, are unnecessary to hold the key links in position on the plate.

HORN.—J. LEVY, 2161 67th St., Brooklyn, N. Y. The invention particularly relates to a sound-producing horn for amusement purposes, and has for an object to provide a simple but strong construction which will not easily get out of order. Another object is to provide a vibrating tongue or mouthpiece, held in place by ears bent from the body of the horn instead of solder or other holding means.

SHOELACE TIP.—H. D. CHAFFEE, 68 Pearl St., South Manchester, Conn. The primary object of the invention is to provide a conical-shaped tip of the above character which is adapted to be quickly and easily attached to the end of a shoelace or the like, the tip being so constructed that it will not become detached from the lace during the use thereof.

TAG.—C. I. MINKOFF, c/o Stout Dress Co., 48 West 25th St., New York, N. Y. The invention aims to provide a device which is adapted to be associated with a garment while the same is upon the hanger, so that the dress will present a neat and slender appearance even while in this position. A still further object is the construction of a device of this character which may be manufactured at a nominal figure, and which also will act as a price tag, size tag, etc.

PROCESS OF LETTERING.—A. N. SANDE, Red Wing, Minn. An object of the invention is to so proportion the letters on a curved or receding surface that the words formed by the letters will have the same appearance as if the surface were a flat one. The invention more particularly relates to the process of lettering labels for cans, bottles, or other cylindrical, angular or receding surfaces.

FAN.—R. I. FAUCETT, c/o Methodist Episcopal Church Mission, Muzaffarpore, Bihar, India. The invention has for its object to provide a fan especially adapted for use in connection with swings, as, for instance, porch swings, for creating a cooling current of air toward the occupants of the swing, and controlled by the swinging of the swing.

OPTICAL TESTING APPARATUS.—J. A. BELL, Box 461, Bremerton, Wash. The object of the invention is to provide an optical testing apparatus, embodied in a cabinet, in which the requisite test charts are presented directly in a patient's line of vision, within a well-lighted aperture or window and which displays but one chart at a time so as not to confuse the patient by requiring him to look at various charts simultaneously displayed.

PRICE CARD HOLDER.—[illegible] c/o Thomas & Thomas, [illegible] Davenport Savings Bank Bldg., Davenport, Iowa. Among the objects of the invention is [illegible]

card holder of simple construction which may be secured to cans, boxes, or the like, in which different commodities are retailed from grocery stores, or the like, for displaying a card having written thereon the price at which the commodity is to be sold.

BUCKLE.—J. G. Fisher, 219 E. Capitol St., Washington, D. C. An object of the invention is the provision of a buckle which is for the most part formed of a single piece of metal, and which embodies a buckle retainer for permanently preventing lateral or horizontal as well as vertical displacement of the buckle while in no way detracting from the clasping action of the buckle or from its features of comfort or attractiveness.

RAT TRAP.—R. F. Kent, Hotel Montgomery, Chambersburg, Pa. A purpose of the invention is to provide a rat trap having a runway in which is removably fitted a cage, and spring actuated means controllable by a platform located in the runway for forcing the rat into the cage when the rat occupies the platform, and for automatically closing the cage so as to confine the animal therein, such means being operable to reset itself after each actuation. (See Fig. 1.)

FOUNTAIN PEN.—N. B. Panoff, 54 E. Seventh St., Brooklyn, N. Y. Among the objects of the invention is to so construct a fountain pen that when the pen is in closed position, the ink reservoir is contracted at its discharge end to prevent feeding of the ink regardless of the position of the pen. A further object is to so construct the pen that when the cap is removed from the rear end thereof the ink remaining upon the nib will be drawn into the reservoir, the operating mechanism being included in the closing cap of the pen.

RING SETTING.—R. Rosenthal, 15 John St., New York, N. Y. This invention relates to jewelry and has for its object to provide a construction wherein the stone or jewel may be readily secured in place without danger of injuring the same. A further object is to provide a ring setting in which a seat is provided for a stone and a clamping ring is threaded thereto, the ring being provided with an edge over which the retaining prongs may be bent.

SHOE TREE.—G. A. Brady, 2008 Green St., Philadelphia, Pa. The general object of the invention is to provide a shoe tree having means whereby the tree will automatically adjust itself to conform to the lines of the shoe and will preserve the normal shape and form of the shoe without stretching or distorting it in any way. The device, being simple in construction, will permit of manufacture at a low cost. (See Fig. 2.)

DISPLAY STAND.—N. Rippenbein, 235 West 71st St., New York, N. Y. This invention relates particularly to that form of display stand commonly used in retail stores to display small packages of candy and similar articles. An object is to provide a stand which will serve to display four sides of rectangular articles placed thereon, and which is provided with numerous surfaces for the display of advertising matter.

ADJUSTABLE BLACKBOARD T SQUARE.—M. L. Curtis, 711 East 10th St., Bloomington, Ind. The object of this invention is to provide a T-square having an adjustable supporting arm for lengthwise adjustment constructed in a simple manner for mounting the same upon a blackboard and provided with a blade, whereby drawings may be executed with facility, and particularly for instruction purposes, the T-square being adapted for use in cooperation with triangles, as in the ordinary use of a T-square.

NUT-CRACKING DEVICE.—G. A. Puepper, address R. L. Clark, Oshkosh, Wis. Among the objects of the invention is to provide a device of this character which is adapted for use in cracking pecans or other nuts of a similar nature. An important object is that the nutcracker be adapted to crack the pecan or similar nut in such manner that the meat may be removed in an unbroken state.

SIGNALING DEVICE.—W. V. Bergen, c/o Shute Savings Bank, Hillsboro, Oregon. The invention has for its object to provide a device adapted to be arranged along highways for indicating danger or the need for caution, wherein a visual signal is provided capable of being seen in daylight, and having means for illuminating the same through the reflection of the headlights of an oncoming car to be visible at night.

GARBAGE CAN.—I. Levy, c/o Nechthouse & Levy, Java Provost & Kent Sts., Brooklyn, N. Y. The principal object of the invention is to construct a garbage receptacle for household use in which there is an inner and an outer receptacle movably arranged together in such manner that the inner receptacle may be readily removable from the outer. A further object is to so construct the parts that they will have interengagement and to prevent movement of the inner receptacle when desired a single cover serving for both.

LAUNDRY FORM.—F. E. O'Brien, 2330 6th Ave., Troy, N. Y. This invention has reference more particularly to a form used for the starching and drying of collars worn by sisters of religious orders. An object is to provide a device for the finishing of collars which will eliminate ironing of the collars and give the collar a dull finish.

POLISHING BRUSH.—C. H. Anderson, c/o Hughes Bosarth Anderson Co., 15-21 East Grand Ave., Oklahoma City, Okla. This invention relates more particularly to shoe brushes, the object being the provision of a strong, durable brush of this nature which may be readily carried from place to place, occupies but small storage space, is practically indestructible, may be readily cleaned from time to time and is capable of effective use without danger of soiling or injuring the hands.

HELMET OR MASK.—F. M. Bowers, 3000 West 9th St., Chester, Pa. Among the objects of this invention is to so construct a headgear for masks that the latter may be adjusted with respect to the head of the wearer in order that it may be used to support masks upon heads of various contour. A still further object is to provide a lens-holding device in masks of this character.

AUTOMATIC RIFLE.—L. W. Wagnon, Casa Grande, Ariz. This invention has for its object the provision of a rifle of the character specified, magazine-fed, recoil-operated and air-cooled, wherein the motive power for the operation of the mechanism is furnished by the recoil of the bolt incident to the explosion, and wherein recoil springs are eliminated.

ARTIFICIAL BAIT.—J. Frame, c/o Penobscot Coal Co., Searsport, Maine. The general object of the invention is to provide an artificial bait with means for giving motions more or less in simulation of the natural motions of a minnow by flexing the articulated tail portion, and by novel fins to cause the bait to turn to one side and rise toward the surface, and to the opposite side and produce a diving action. The hooks have flexible guards concealing them, but yielding to the attack of a fish. Fish oil may be caused to exude from the bait through its tail and sides as a lure.

DISH SCRAPER.—F. Beuckmann, 534 No. 22d St., East St. Louis, Ill. An important object of the invention is to provide a cleaning device having a scraping head of rubber or other flexible material capable of bending slightly so that the same may be employed for cleaning the sides and bottoms of cooking utensils and dishes. The device is especially applicable for use in candy shops, bakeries, laboratories, etc. The exterior of the scraping blade is smooth and may be easily cleaned by being drawn over the edge of a refuse pail. (See Fig. 3.)

GATE VALVE.—M. C. Christensen, c/o R. F. Radebaugh, 1801 South 60th St., Tacoma, Wash. The invention relates to valves used for drawing off the contents of molasses barrels and the like. An object is to provide a gate valve with automatic locking means which will operate to lock the valve in closed position so that accidental opening thereof will be prevented, the locking means being so constructed that it will snap into place the instant the valve is closed.

APPARATUS FOR SUPPLYING AIR TO THE EXTERIOR OF HULLS OF SHIPS.—F. G. Trask, Ross, N. D. Among the objects of the invention is to supply air to the exterior surface of the hull of a ship, beneath the level of the water whereby the speed of the ship may be greatly increased. An important object is to provide apparatus which is adapted to supply a sheet of compressed air to the exterior hull of a ship, in contact therewith, and which apparatus is adjustable to vary the thickness of the sheet of air.

SORTING RACK.—T. Hawkins, 440 Hanover St., Derry, N. H. Among the objects of the invention is to provide a sorting rack for letters which will expedite the work of mail carriers in arranging letters for their respective routes. A further object is to provide a rack of the character described which will be simple and practical in construction and strong and durable in use.

ARTIFICIAL SILK.—R. D. Lance, 18 Rue Saint-Claude, Livry, France. The invention has for its object the production of artificial viscose and nitrocellulose silks of great strength and from which fabrics that can even be washed in boiling water can be made. In accordance with the present invention such a silk is obtained by adding metallic resinates to cellulose esters such as a solution of viscose or of nitrocellulose and then spinning the mixture.

SAMPLE CARD.—E. Hirtz, 5 Rue d'Alexandrie, Paris, France. The invention relates to a sample card for fabrics, silk goods, wallpapers, and the like, by means of which it is possible to display, take off and replace at will the samples, and bring the same together. The cards are so arranged that the samples may be quickly changed. These sample cards are not cumbersome or bulky and can be used indefinitely.

LOCK.—J. L. Yates, 1257 Washington Ave., Bronx, N. Y. Among the objects of the invention is to provide a combination catch and bolt lock apparatus having means on the inside of the door for manipulating either the catch or the bolt without the key, but having means within the lock whereby the catch and the bolt are movable independently of each other by the key in different positions.

FRAME FOR PRINTERS' FORMS.—L. G. Garbe, 662 Clayton St., San Francisco, Cal. Among the objects of the invention is to provide a method of binding printers' forms which consists in the use of a plurality of frame members having registering tongues and grooves at either end, and being adapted to be interchangeably locked into rectangular frames of various sizes, and of set-screws for yieldingly securing the frame members to one another.

COOKING DEVICE.—Kate A. Weisgarber, Vibank, Saskatchewan, Canada. The invention relates to a device for use in making cookies and has for its object to produce a device so constructed that it may be heated by plunging it into hot fat, and may be dipped into the paste for picking up the desired quantity, and the article to be quickly cooked by again plunging the device with the paste thereon into the hot fat. A further object is to so form the device that the cooked article may be ejected.

VALVE.—M. Blum, 504 Myrtle Ave., Monrovia, Cal. An object of the invention is to provide an outlet valve for steam radiators which will allow the escape of air but will automatically close when steam starts to escape therefrom. A further object is to provide a valve in which the moisture and heat of the steam act upon an expanding member to close the outlet passage after the air has escaped.

Hardware and Tools

WRENCH.—B. G. Patterson, 1111 W. 15th St., Oklahoma City, Okla. The invention has for its object to provide a wrench which is quickly adjustable to operate upon various objects, which is self-locking, which may be readily released with the thumb of one hand, and which is of simple and durable construction, reliable, and inexpensive to manufacture.

CORNER LOCK.—W. J. Marvin, 648 Monroe St., Brooklyn, N. Y. The invention aims to provide a device adapted for use in connection with bedsteads, an object being to provide a corner lock serving to effectually support the cross and side angles in such a manner that no play can come into being between the various parts of the bed. The device is capable of association with any type of bed.

WRENCH.—C. A. McIlvaine, Balboa Heights, Canal Zone, Panama. An object is to provide means for moving the movable jaw of the wrench so as to effectually grip a nut or permit a release of the same after the initial adjustment is made. A further object is to provide an arrangement of thumb or finger lever which operates as a cam to impart movement to the movable jaw and which may be in its extreme position to lock the jaws or the nut.

FASTENING HINGE.—J. A. Brady, 1027 Park Ave., Hoboken, N. J. The invention relates to a fastening hinge for use in combination with a display stand, which comprises panels, and risers and treads supported by the panels, means adapted to movably connect the risers and treads with each other, and further means adapted to engage the panels supporting the risers and treads for rigidly connecting these elements together.

SAFETY RAZOR.—W. Nowak, 1797 Clinton St., Buffalo, N. Y. This invention particularly relates to that type of safety razor employing double-edged blades clamped upon the outer convex face of a guard plate and between this guard plate and the clamping plate. The object is to provide a construction whereby the clamping plate may be secured in connection with the guard plate in

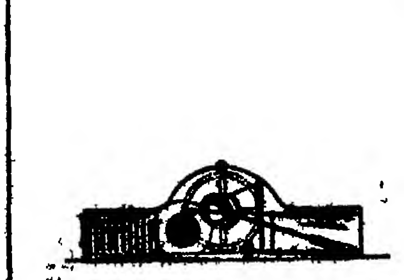


Fig. 1. Rat trap that will catch a second rat while the first is still [illegible] patented by R. F. Kent

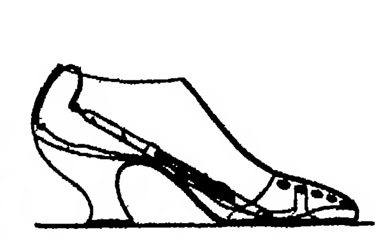


Fig. 2. G. A. Brady's automatically adjusting shoe-tree, which conforms to the shape of the shoe

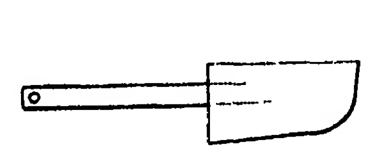


Fig. 3. Scraper with flexible head, for cleaning pots, pans and dishes, put out by F. Beuckmann

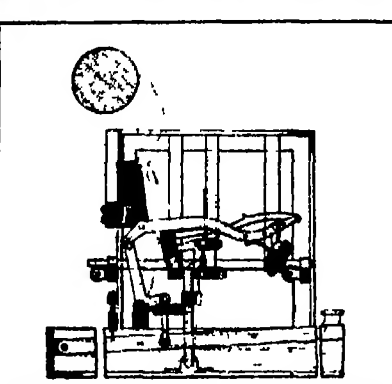


Fig. 4. The ribbonless typewriter invented by E. Winterer. (See page 280 for description)

such a manner as to permit of its ready association therewith and disassociation therefrom.

HACKSAW.—M. C. Gibson, 427 East 84th St., Los Angeles, Cal. An object of the invention is to provide an adjustable frame hacksaw that may be used with any usable length of saw blade. A further object is to provide a structure in which any portion of a broken saw blade may be used without any preparation to the ends of the pieces, or providing the same with connecting means.

TEMPER SCREW FOR WELL DRILLING TOOLS.—R. E. Neilson, 417 East 1st St., Tulsa, Okla. One of the foremost objects of the invention is to construct a temper screw so as to render the tool far more durable than ordinary temper screws, many of the parts being interchangeable and quickly replaceable, so that repairs can be rapidly made. A further object is to provide reversible and interchangeable reins, in which the head and jaw extensions to which the reins are secured are themselves replaceable in cases of breakage.

EXTENSION BIT.—P. Barmaison, 1234 Diamond St., San Francisco, Calif. The invention has for its object the provision of means for increasing the strength of the bit and so reinforcing the cutters that the bit will not stick even if the brace is not held steady. Another object is to provide ample clearance for the shavings, and this clearance may be easily adjusted and held very close to the center of the tool. Further objects are to provide a clamp adapted to hold bits of various thicknesses, and to provide a bit which may be easily sharpened.

COMBINED GAGE.—F. G. Morin, Jr., 1004 20th St., San Francisco, Calif. The invention relates to a sheet metal gage which is especially adapted for use by carpenters, joiners and like workers in the marking of striking plate, lock, hinge mortise and other similar cuts on doors, door jamb rabbets and similar structures. The primary object is to provide a simply constructed, easily adjusted gage which may be used for making various markings without necessitating readjustment for each different marking.

PLANE.—E. J. Sweeney, 707 S. Winnebago St., Rockford, Ill. Among the objects of this invention is to provide a practical form of adjusting means for the bit of the plane which will serve to regulate the depth of cutting of the plane and to adjust the bit for wear, the invention embodying structural features which also tend to add strength to the tool.

COMBINATION LOCK.—F. Clark, 6 Calle de Juarez 82, Durango City, Mexico. Among the objects of the invention is to provide a combination or permutation lock of simple and compact construction in which a plurality of tumbler members adapted to be actuated by a key are provided with a means which may be readily adjusted to determine the movement of the tumblers to permit the movement of a bolt control member. A further object is to provide a key construction having a body core portion and a means rotatably mounted thereon for receiving longitudinally adjustable ward members.

LOCK.—C. Lieberman, 1732 Madison Ave., New York, N. Y. The object of the invention is to provide a lock more especially designed for use on doors and arranged to lock the door securely to prevent opening by unauthorized persons. Another object is to prevent retraction of the bolt by the insertion and manipulation of thin bladed tools or other implements.

Heating and Lighting

HEATING STOVE.—C. A. Burridge, c/o Burridge Studios, St. John, Mich. The purpose of this invention is to produce a heating stove formed with a plurality of flues so arranged as to provide a circulation of air both interiorly and exteriorly of the stove and from different strata of air whereby full and complete radiation and circulation is effected and the heating of all strata of air within the room.

FIRE-KINDLING DEVICE.—F. Lynes, Johnstown, N. Y. Among the objects is to provide a device which in its entirety is an article of manufacture and in which all of the several parts are formed from combustible material capable of complete consumption in the presence of fire. The device is so constructed that it is capable of use in the firebox of any of the ordinary types of stoves, furnaces or house-heating boilers.

Machines and Mechanical Devices

TYPEWRITER.—E. Winters, 320 Wilcox Bldg., Los Angeles, Calif. The invention while relating to typewriting machines in general, has reference more particularly to ribbonless typewriters. The primary object is to provide a comparatively simple construction in ribbonless typewriters and particularly a construction in which a cooperative relationship of parts is so arranged as to provide a most efficient operation in such machines. (See Fig. 4, page 279.)

WATER RIGGING FOR STOPPING DRILLS.—W. H. Joyce, 301 E. 5th St., Leadville, Colo. This invention relates more particularly to mining drills, for instance, coal drills where the rapid accumulation of dust has a tendency to clog the action of the drill. An object is to provide a simple and convenient water rigging, by means of which a stream of water may be injected directly against the bit in action, and a further object is the provision of a water rigging which may be readily adapted to a stopping drill.

OIL CUP.—W. H. Lindenfield, 320 No. Clifton St., Lexington, Tenn. The invention has for its object to provide mechanism in connection with oil cups of the Hancock inspirator type for preventing accidental displacement of cover and feed valve, due to jars from the machinery upon which the cup is used. A further object is to provide mechanism in connection with the valve stem for locking the stem to permit the feed to be regulated.

SAND SETTLER.—I. A. Karns, c/o New Oklahoma Hotel, Tulsa, Okla. The object is to provide a settler which may be easily attached to the working barrel of a deep well pump and adapted to cause any sand which may be carried into the settler with the oil, water or other liquid being pumped from the well, to be entirely settled or precipitated from the oil or water before the same passes into the working barrel of the pump.

HEADLOCK FOR PRESSES.—E. C. Rudoll, 304 Hatten Ave., Rice Lake, Wis. This invention relates more particularly to head blocks adapted for use in connection with excelsior or hay presses. An object being to provide a construction of head block providing grooves for the accommodation of bale-tying wires and which is so constructed as to efficiently house the wire and yet permit the removal of same as occasion may require.

PUMP.—H. S. Tooker, The James Boiler & Machinery Co., Joplin, Mo. An important object is to provide a pump having means whereby the same may be operated at a point remote from the same so that a pump operating apparatus in the form of a steam engine or the like need not be installed with the pump. A further object is to provide a pump which may be operated on the surface of the water, or submerged, or arranged in a variety of positions, or suspended in midair as when hanging in a mine shaft.

MORTISING MACHINE.—W. T. S. Pate, 711 Bates St., Indianapolis, Ind. One of the foremost objects of the invention is to provide a machine for cutting the bolt slot and rebate in objects such as furniture drawers and the like. A further object is to provide a machine by means of which an elongated cavity may be bored with a surrounding relatively shallow depression or rebate, the idea being to provide a place into which either a block or guard plate may be set.

CHENILLE UNTWISTING AND WINDING MACHINE.—G. C. L. Tisch, 454 Spring St., Elizabeth, N. J. Among the objects is to provide a machine timed to operate in proper step with the machine which forms the chenille so that it may produce an automatic untwisting action as fast as the chenille is manufactured. The untwisting mechanism is comparatively small, and consequently requires but little space to properly untwist great lengths of chenille. A still further object is to provide a machine for winding the untwisted chenille on a drum ready for disposal in any desired manner.

METER FOR MEASURING GRANULAR MATERIALS.—E. Oour, 34 Park Ave., East Orange, N. J. The invention has reference more particularly to a meter provided with a discharge screw whose rotation is automatically stopped when no more material is supplied to the meter. An object is to provide a meter which will continuously discharge granular material therefrom and register the amount of the material discharged.

ESCAPEMENT FOR TIMEPIECE.—L. Greenwald, 236 West 118th St., New York, N. Y. The object of the invention is to provide a construction in which the usual hair spring is eliminated and a coil spring substituted. Another object is to provide an escapement in which a coil spring is utilized together with a system of gearing whereby the balance wheel may be caused to travel less or more than one revolution upon each of its back and forth movements.

POWER TRANSMITTING DEVICE.—W. J. Francke, Highland Park, N. J. This invention has for its object to provide a transmitting device more especially designed for transmitting power by angularly disposed shafts. Another object is to compensate for the non-circular path and the irregular angular advance of one coupling member relative to the other, to insure a continuous driving of the driven transmission shaft from a uniformly driven driving or motor shaft.

PISTON RING.—T. G. Saxton, c/o Yale Piston Ring Co., Boonton, N. J. The invention aims to provide a two-part piston ring in which the inner part of the ring is formed of a highly expansible material, and such inner part is encircled by an outer ring of less expansible material. The two parts of the ring cooperate with one another to automatically expand to the limits of the groove in a direction parallel to the longitudinal axis of the piston.

PUMP.—J. R. Tinney, 507 N. Ninth Ave., Phoenix, Ariz. Among the objects of the invention is to provide a rotary pump in which the elements are so constructed and arranged that the pump may be securely though detachably suspended in the well and will deliver a volume of fluid limited only by the cross section of the well casing, all surging and whirling being eliminated, thereby attaining the maximum output with minimum construction of power.

FRUIT SIZING APPARATUS.—F. J. Pearson, R.F.D. No. 5, Box 78, Troy, Ohio. The primary object is the provision of a construction which provides for more effective sizing and avoids the danger of inaccurate grading as well as one which in certain other respects provides for effective cooperation of the parts in the automatic feeding of fruit to the sizing members so that the feed is uniform and also without danger of injury to the articles being fed.

PUMP.—F. Roberts, Elissville, Texas. This invention has for its object to provide a pump especially adapted for use with oil wells, for pumping oil, wherein the pump has a double barrel and a double plunger, together with valves arranged to permit the plungers to function simultaneously to lift the oil.

EMBOSSING DEVICE.—V. E. Baker, 418 E. Broad St., Elyria, Ohio. An object of this invention is to provide an embossing device that embosses and cuts off a thin strip of metal during part of its operation and automatically feeds another portion of the strip to be embossed during another part of its operation. The device is simple in construction and thoroughly efficient in operation.

TICKET PRINTING DEVICE.—N. Bonoom, Lake Mills, Iowa. Among the objects of the invention is to provide a device having a plurality of relatively movable type-holding disks which can be arranged to permit the printing of various values on a ticket strip, so that the portions of the ticket strip successively printed can be torn off when printed and used as desired.

SHOE LAST REMODELING MACHINE.—O. Olson, 129 Clemont Ave., Brooklyn, N. Y. The invention relates to a machine for the remodeling of old lasts. An object being to provide a machine which will remodel a plurality of lasts in exact conformity with a pattern last and perform the work with a minimum of labor so that shoe lasts can be quickly, cheaply and accurately remodeled.

CORNER CUTTING GAGE FOR PAPER CUTTING MACHINES.—V. T. Rybicki and B. Greenfield, address V. T. Rybicki, 1194 Brook Ave., Bronx, New York. The primary object of the invention is to provide a simple and inexpensive gage in the nature of an attachment for a flat paper cutting machine which is adapted to be associated with the back gage and which is universally adjustable with respect thereto for accurately positioning and retaining a stack of paper relative to the knife.

WASHING MACHINE.—H. Metzot, Red Bank, N. J. Among the objects of the invention is to produce a power washing machine of the reciprocating plunger type in which the articles washed are subjected to varying amounts of pressure. It is a further object to provide a pivoted platform for supporting the driving mechanism of the plungers in such manner that the plungers and their reciprocating means may not be subjected to undue strain.

AUTOMATIC DUPLICATING MACHINE.—T. A. Steinmetz, address A. H. Shoemaker, Eau Claire, Wis. The invention relates to a machine in which duplication will be effected, and which may be relied upon to be an accurate reproduction of the pattern. An object is the construction of a machine which shall be entirely automatic aside from starting and stopping the same, so that defects incident to the human equation are eliminated.

GEARING DRIVING UNIT.—F. J. and J. L. Muench, General Machine Co., 398 Market St., Newark, N. J. The invention has particular reference to gear driving units for chemical agitators. Among the objects is to provide a unit in which certain parts may be readily removed for repair and replacement without dismantling the entire apparatus, and whereby the driving and driven shafts are so arranged that a plurality of units may be readily connected together and driven from a common source of power.

CENTRIFUGAL CASTING MACHINE.—C. F. Bloom, Box 96, Bend, Oregon. The foremost object of the invention is to provide a preferably hand-operated casting machine for dental purposes, wherein the flask or mold containing the molten metal is first elevated in the vertical part of a subsequently semicircular track, being gradually thrown outwardly along a spiral line until it reaches the end of said track, where it is spun in a circle so as to force the metal into the crevices by virtue of the centrifugal action.

COLOR SORTING MACHINE.—P. F. Dusha and A. Fetk, 1797 1st Ave., New York, N. Y. The invention has particular reference to a machine for sorting buttons. An object is to provide a machine in which the buttons are fed and presented successively to operators with the sides of the buttons reversed so that the operators can examine both sides of the buttons without any manual aid, to sort them if the color or other characteristics are not what is desired.

CANE SUGAR MILL.—J. Meinecke, Paia Maui, Territory of Hawaii. The invention has for its object to provide a cane chute by which the bagasse may be properly pushed or conveyed from one mill to the other without injury or distortion from pressure, as well as obviating the necessity of employing a conveyor of the slatted or belt type and eliminating the large number of complicated parts employed in the chain type of conveyor, thereby reducing the cost of construction as well as maintenance and upkeep.

Medical Devices

ORTHOPEDIC APPLIANCE.—L. S. Doyle, 409 East 6th St., Austin, Texas. The object of the invention is to provide an appliance which is adapted to exert a pressure upon the spinal column in the lumbar region so as to maintain the vertebrae in proper position and relation, thereby relieving the associated organs and muscles of abnormal strains and restore these portions of the body to normal position and condition.

Musical Devices

AUTOMATIC PHONOGRAPH STOP.—C. H. Taylor, Crosby, Minn. An object of the invention is to provide a stop for a phonograph or like sound producing machine which is adapted to be automatically operated to stop the rotation of the turntable when the direction of movement of the tone arm of the machine to which the stop is applied has been reversed. A further object is to provide a device that normally prevents rotation of the turntable when the tone arm is out of operating position.

PNEUMATIC ACTION UNIT.—S. Battner, 100 Eagle St., Brooklyn, N. Y. This invention relates to pneumatic actions such as are commonly used in connection with player pianos, organs, and like instruments. Among the objects is to provide facilities for utilizing independently manipulated pneumatic units whereby any of the units may be easily reached for inspection, repair, interchange or the like, at any time and without disturbing any other of the units.

MUSIC HOLDER FOR BAND USE.—T. P. Noonan, Jr., Livingston, S. C. The invention relates to holders especially

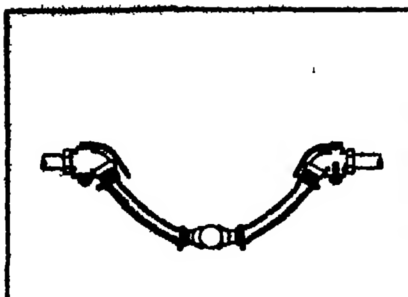


Fig. 5. Cut-off relief and automatic-control air-brake valve, by R. P Clauss

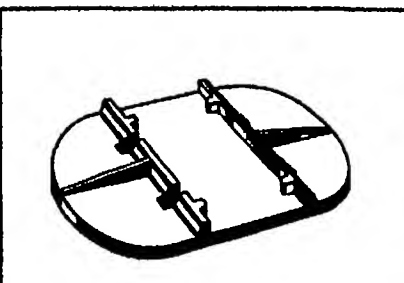


Fig. 6. Rail chair designed by A. Vansile to avoid creeping, running and spreading

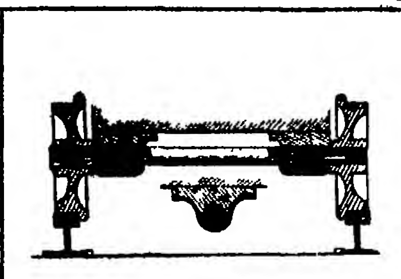


Fig. 7 Running gear that promotes easy lubrication, patented by R. D. Scott and J G. Cadwell

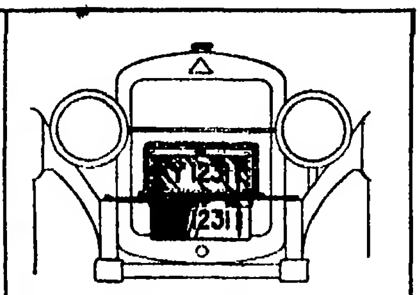


Fig. 8. C. W Zint's invention for preventing the unauthorized driving of automobiles

adapted for instruments such as cornets, bugles, etc. An important object is to provide a sheet music holder having means whereby the several sheets of music may be automatically advanced to a position where the desired sheet may be conveniently selected and played. A further object is to provide means whereby the sheets will be protected from rain.

BRUSH FOR TALKING MACHINE RECORDS.—J. F and W. Bobst, 1117 Cypress Ave., Ridgewood, Brooklyn, N. Y. The present invention pertains more particularly to an attachment for the sound box or reproducer thereof. An object is to provide a brush which is capable of use with sound boxes so mounted as to adapt them for playing records of both hill-and-dale and lateral types engaging the record in advance of the stylus of the sound box and in the path of the stylus in order that the grooves may be cleaned of foreign matter

Prime Movers and Their Accessories

COOLING, CLEANSING AND FILTERING DEVICE FOR GAS.—D J Smith, 40 Woodberry Grove, Finsbury Park, London, N 4., England. The invention relates to an apparatus which is generally known as a gas scrubber, as used in connection with suction gas plants for supplying internal combustion engines. This invention is also applicable to other types of gas-producing plants, or for other gas from which it is desired to remove any matter held in suspension and also reduce the temperature of the gas to the desired degree.

VAPORIZER.—H. Epstein, J J Mitnick and J. M. Bernstein, c/o J J Mitnick, 1859 S. Troy St., Chicago, Ill. An object of the invention is to provide a vaporizer for internal combustion engines, having electrical heating elements so arranged that the maximum amount of heat is transmitted to the gases passing from the carburetor when the throttle valve is at or near closed position, while a minimum amount of heat is given off when the valve is wide open. A further object is to provide a device in which the heat is gradually decreased from maximum to minimum.

VAPORIZER.—H. L. Bumbaugh, Phi Kappa Pi, Stanford University, Calif. This invention aims to provide a vaporizer which will permit of practically the instantaneous starting of the consuming element, such as an explosive motor, so that it will be only necessary to actuate the starting crank to a small extent, or if a starter is used the same will be operated for merely a proportionate amount of time to produce an explosion, thus saving the battery from damage and distortion incident to a continued operation of the starting motor.

AUTOMATIC FUEL CONTROL.—T W Crane, 620 No. J St., Imperial, Cal. The object of this invention is to provide a two-tube system, wherein the fuel tank is connected to the carburetor fuel chamber by an air pipe and a fuel pipe, the arrangement being such that as fuel is withdrawn air will be admitted to the fuel tank to permit fuel to feed from the tank to the fuel chamber of the carburetor. A further important aim is to provide means wherein the vacuum tank and the pipes leading therefrom to the carburetor constitute the sole means for maintaining the fuel level, thereby dispensing with the necessity of a float and associated parts.

Railways and Their Accessories

CUT-OFF RELIEF AND AUTOMATIC CONTROL AIR BRAKE VALVE.—R. P Clauss, Lyons, N. Y. An object of the invention is to provide a valve for air brake systems which will not [illegible] and will, therefore, either bleed the line or hold the same close and the brakes properly released. Another object in view is to provide a construction of valve which will not depart radically from the present construction, but will prevent accidents through the improper turning of any valve (See Fig 5)

CAR COUPLING.—L. and F Pignani, c/o Sam W Miller, Blairsville, Pa. The invention relates to automatically operated car couplings of the link and pin type. The purpose is to provide a car coupling which is particularly, although not necessarily, adapted to use on mine cars, the coupling containing the desirable features of simplicity, durability, efficiency and constructed to make and maintain the coupling at all times and under most difficult conditions.

RAIL CHAIR.—A Vansile, 305 Wisconsin Ave., Long Beach, Calif. The invention has for its general object to provide a rail chair so formed that when spiked to the tie and engaging the rail it will afford resistance to the creeping or running of the rail and the spreading of the rails. Among the objects is to provide lugs to enter recesses in the rail serving to effect an interlocking engagement between the rail and the chair (See Fig. 6.)

SAND DISTRIBUTING APPARATUS.—T L. Swearingen, Box 274, Danville, Ky A purpose of the invention is the provision of an apparatus in which manually operable means is provided for shifting the distributing nozzles laterally with respect to a railway track so as to cause the nozzles to be at all times directly above the rail and to thereby deposit the sand on the rail irrespective of the angular position of the locomotive. Pneumatically operative means are provided for delivering the sand to the nozzles.

RUNNING GEAR FOR MINING CARS.—R. D Scott and J G Cadwell, Box 944, Roslyn, Wash. The object of this invention is to provide an oiling arrangement whereby it will be insured that the journal axle of the running gear will be continuously and thoroughly lubricated It is also an object to provide a journal box for the axles comprising a solid casting having a transverse recess in its lower base adapted for journalling the axle, and in which an oil retaining agent may be placed. (See Fig. 7)

RAILWAY SWITCH HEATER.—W T Lawlor, 68 Wayne St., Jersey City, N J The invention relates to switch heaters in the form of a plurality of oil pans which may be located between the ties and under the rails of a switch mechanism, and in which the oil is burned to keep the switches open in winter storms. A special object is to provide covers for the pans, which will prevent water collecting therein during rain storms, but which may be quickly removed when the pans are wanted for use.

SAFETY DEVICE.—W J Burke, 2532 Hillman St., Youngstown, Ohio. An object of the invention is to provide means by which any possibility of the switch being accidentally thrown upon a train passing over the same is absolutely prevented. A further object is the provision of a device which shall be entirely automatic, so that difficulty incident to the human equation is avoided, the construction being such that it will cause a complete throwing of the switch, even though the parts of the same have been left in partly closed position.

PNEUMATIC CONTROL FOR LUBRICATORS.—C. F. Hoover, 549 West Washington Boulevard, Chicago, Ill. The invention relates to a device for controlling air for actuating lubricators. An object is to provide an automatic air control device which will operate when the control lever is moved, as, for instance, by the swinging of a truck when a train goes round a bend, and which will shut off the flow of air to the lubricator when the pressure has reached a predetermined maximum

Pertaining to Recreation

GAME.—G Miller, Denham Springs, La More particularly the invention relates to games involving the use of a board, movable pieces, and missile throwing devices, the purpose of which is to upset the movable pieces, the board being divided into playing surfaces, each being the objective field of the missile throwing device, the spaces being separated to form a dormant area for misplaced shots.

TOY VEHICLE.—F H Miller, 138 Stephen St., Ridgewood, L I, N Y The invention relates to a toy vehicle built to imitate an automobile An object is to provide a body portion which will imitate the long, narrow body of a high speed automobile, and to provide means whereby the operating parts of the vehicle are closed from contact with the operator as much as possible to prevent soiling the clothes of the child.

TOY SPINNING TOP.—J Popper, 143 West Broadway, New York, N Y An object of this invention is to provide a construction in which a top body is provided with means indicating a ball structure in action with an ornamentation therein. A further object is to provide a top with removable ornamentations or characters, and a handle which is so arranged that when the top is in action the handle will appear as a transparent ball, and the figures will appear to move.

AMUSEMENT DEVICE.—J Sayih, 406 Gold St., Brooklyn, N Y The principal object of this invention is to provide a device of the carousel type which includes a plurality of annular series of cars and means for driving the same in circular undulating paths and in opposite directions whereby to impart to the riders an amusing sensation, each series being driven at different rates of speed whereby the riders may have a choice of selection

ELECTRICAL AMUSEMENT APPARATUS.—S J Levi, 25 Milton St., London, England The invention relates to an electrical amusement apparatus of the kind giving a visual or aural indication when a player has achieved success, by the provision on or above its surface of a plurality of electrical contact pieces connected with one or more indicating devices, and separate means adapted to be moved by the skill of the player on to said contact pieces so as to close the electric circuit.

INDESTRUCTIBLE TOY TRAIN.—R. E Bloomfield, 16 West Eleventh St., Jacksonville, Fla. It is the object of this invention to provide a practically indestructible toy railway car from a single piece of wood which may be bored lengthwise for saving in weight, and which is otherwise of solid construction, with smooth, unbroken sides, although countered at the top so that by means of side decorations the representation of the car may be made unmistakable.

Pertaining to Vehicles

MOTOR CAR ATTACHMENT.—D W Newberry, c/o Schell Motor Co Virginia, Ill. The object of the invention is to provide an attachment especially adapted for use with Ford cars and for attachment to the clutch and low-speed pedal, for locking the transmission in the low-speed when desired, as, for instance, in climbing hills or in traversing mud, sand or the like, so that the driver does not need to hold the pedal in operative position with his foot.

MOTOR VEHICLE.—F A Johannknecht, 179 Jayne Ave., Patchogue, N Y The invention has for its object to provide a motor vehicle the body of which when in motion is supported by two wheels, one of which is the guiding wheel and the other the tractor wheel A further object is to provide mechanism in the form of a pair of small wheels which can be lowered by a pedal to support the vehicle in upright position when at rest

AUTOMOBILE IDENTIFYING DEVICE.—C W Zint, 206 Ft. Thomas Ave., Fort Thomas, Ky The primary object is to provide means by which an automobile may be properly identified in order to prevent surreptitious use thereof A further object is to provide two license plates at the front, which license plates contain corresponding data During such time as the vehicle is not being operated, the upper license plate is removed by the owner, whereby it may be ascertained whether or not the automobile is being operated by the owner or a person unauthorized (See Fig 8.)

VACUUM BRAKE.—R. W Catching, E. Oak St., Roseburg, Oregon The invention relates to brakes for vehicles employing internal combustion engines, the primary object being the provision of an effective fluid pressure brake arrangement, actuated by the suction of an internal combustion engine and capable of attachment to the foot actuated brake connections of an automobile, motor truck or the like to permit of free actuation of the foot actuated parts.

TRACTOR.—O L Lewis, 336 W 65th St., Chicago, Ill The invention includes a frame and motor a transmission case rearwardly of the motor, rear-driven wheels, a rotatable steering member in the forward portion of the frame front steering wheels, an adjustable connection uniting the axle with the rotatable steering member and hand-controlled power actuated connections leading forwardly from the transmission case and engaging the rotatable steering member to control and actuate the latter

SPRING.—P Ferrier, "Portland,' Roma. The object of the invention is to provide a leaf-spring which is so completely encased that it is protected against the deleterious action and effects of rain mud or grit which ordinarily find their way to springs. The device is of extremely simple and durable construction, reliable in operation, easy to repair and maintain, and inexpensive to manufacture

Designs

DESIGN FOR A SHOVEL.—F A Verdetis, Millburn, N J

DESIGN FOR AN OILCLOTH TABLE COVER.—C Bastow, c/o T R. Goodlake & Sons, 350 Broadway, New York, N Y

DESIGN FOR A BOTTLE.—E. E. Baker, Box 1187, Pittsfield Mass.

DESIGN FOR A CHARM.—Emma B. Riegel 45 John St New York, N Y

Science Notes

A Digest of Everything of General Interest Appearing in Current Literature

Father Zahm Dead.—Father John A. Zahm, companion of Roosevelt on his journey through the South American wilds, and author of many works on South America, died in Munich on November 11th, 1921

Bodies of Arctic Explorers Are Found.—The Russian expedition exploring Siberia has discovered the bodies of Knudsen and Tessen, two members of the Amundsen party who were lost in the winter of 1910. The bodies were found "near the mouth of the Janesey"

Oldest Medical Faculty.—The University of Montpellier, France, has a medical school tracing back to the tenth century, in the coming celebration of the 700th centennial of its official recognition, a monument to Rabelais, one of its brilliant alumni, will be unveiled

The Value of Sunlight.—The Medical Research Council finds that the metabolism of children exposed to sun and air at the Treloar Hospital is nearly 40 per cent above that of children kept within doors, also that at the seaside the body-heat production is increased 5 times by paddling along the shore, and from 8 to 10 times by swimming.

A Gorgas Memorial in Panama.—A memorial, which will probably take the form of an institution devoted to research work, is to be erected in Panama to Surgeon General Gorgas. His wonderful sanitation work in the Canal Zone is worthy of some such permanent testimonial Funds will be solicited from scientific and philanthropic organizations and from individuals.

Mouse-Tracks in African Snow.—Prince William of Sweden obtained during his African hunting trip a fine zoological collection for the Royal Museum of Stockholm—1000 mammals, including 12 gorillas, 2000 birds, and more than 6000 insects. In climbing great volcanoes to an altitude of 18,000 feet he found snow on which were the tracks of mice, although intense cold prevailed there

The Tides and Semi-Marine Life.—An English writer traces the abundance of sedentary or fixed forms and the widespread phenomenon of stereotaxis among free-swimming species to the direct action of wave impact, the shore zone, from its periodic changes in tide level, formed an effective bridge between aquatic and terrestrial life. The case of *Convoluta* is quoted in support of the theory

Antarctic Discoveries.—J L. Cope, the explorer, returned to Plymouth, England, a year ahead of schedule, he had discovered extensive, workable mineral deposits and gained valuable knowledge relating to fisheries, including the secret migrating places of whales. After exploiting these finds, he plans to go back, taking his wife with him, in which case she will be the first woman to set foot on the Antarctic continent.

Fire-Colored Sunsets.—An approaching hurricane may affect the atmosphere and the rays of light passing through it for more than a thousand miles. When a true flame-colored sunset is seen during the hurricane season below the 35th parallel, even when there is no particular fall in pressure, it is wise to hurry to safety This awe-inspiring phenomenon may precede the sea swell and upper cloud movements by from 24 to 48 hours, and may be the only timely warning of the dangerous tropical storm of small diameter

Prof. Nernst Elected Rector.—Walter Nernst, recently elected rector of the University of Berlin, is the inventor of the Nernst lamp. He studied under Helmholtz, was a coworker with Ostwald in developing the ion theory, is the author of scientific works, and in 1914 received the Nobel Prize for inventions. His election to the rectorship of the University, with which he has been connected for 15 years, emphasizes the dominance of applied science, in Germany, over academic considerations, and her desire to turn all education to practical ends.

Rasmussen's Program.—The motor schooner "Sea King" carrying the Knud Rasmussen Arctic Expedition, left Godthaab, Greenland, on the 7th of last September for the coast of Labrador, where scientific investigations will be pursued; thence the party will proceed to Lyon Inlet, in the Melville Peninsula, and from there the vessel will sail to St. John's, Newfoundland. Rasmussen's task is to explore and map the archipelago between Greenland and the American continent, at the same time investigating the folklore and migrations of the Eskimos. Cape York Eskimos accompany the expedition.

The Seismograph Simplified.—In place of the delicately adjusted levers by which an earth tremor is translated into a line record, a new device uses a small mirror, so hung as to oscillate freely with any earth movement. This mirror receives a beam of light from an electric lamp, which is reflected upon a strip of sensitized paper moving continually at a uniform speed. Since the reflected ray moves through an angle twice that of the angular motion of the mirror the oscillations are magnified twofold. The paper strip, removed and developed, plainly shows the vibrations to which the apparatus has been subjected.

Possibilities of the Soya Bean.—"Manna" milk from the soya bean is now being made in Vienna at one-sixth the cost of fresh milk, in proteid, carbohydride and fat content, and in color, it closely resembles cow's milk, being, of course, free from milk-borne diseases. Butter and cheese can also be made from the bean, and "manna" flour, one part of which equals in nutritive value two parts of meat and one-third part of wheat flour So, at least, Dr Berczeller, a young Hungarian scientist, tells us, he designates the soya as an ideal food containing 40 per cent albumen and 20 per cent fat.

A Prehistoric Engraving.—The present owner of Jacobs' Cavern, near Pineville, Missouri, writes to *Science* of his discovery of a number of interesting artifacts including bone and horn awls and engraved and polished stone implements, with portions of an adult human skeleton. A most important specimen was a bone bearing on one side an engraving of what seems to be a mammoth or mastodon and on the other a deer Dr Clark Wissler of the American Museum of Natural History has been reexamining the cavern, photographs of the more important finds are being prepared, and a detailed report of operations will doubtless soon be made public

Years Added to the Life Span.—Since 1909, according to the findings of the American Emergency Council's Committee on Elimination of Waste in Industry, the duration of life has lengthened by five years and the nation has benefited to millions of dollars by lessened disability and sickness There is still a standing sick list of 2,400,000 persons, but this is a marked reduction from the 3,000,000 of 1909 The improvement is due, not to any physical advance of the race, but to "a mitigation of the struggle for existence and a protection of the community from communicable disease." A survey of five basic industries shows that the average individual now loses only seven days annually from sickness, as compared with thirteen days in 1909.

Luminous Watch Dials.—How radium, costing $120,000 a thimbleful, can be used on cheap clocks and watches is a puzzle to the average man Properly understood, it is a demonstration of the remarkable powers of this substance. The paint used is a combination of zinc sulfide with an infinitesimal quantity of radium. Examine a luminous dial through a magnifying glass after the eyes have been in total darkness for a few minutes, and tiny flashes of light may be seen, these are caused by the explosion of hundreds of millions of radium atoms, and occur at the rate of about 200,000 a second, the more radium in the paint, the greater the number of flashes per second, and the more durable the luminosity. Since every flash means a blow upon a crystal of zinc sulfide, the crystals gradually break under the strain; the zinc breaks down in about five years, but the one-millionth gram of radium on the average watch dial is practically as energetic as ever.

Miscellaneous Notes

Muir Woods National Monument.—By public proclamation, President Harding has accepted and added to the Muir Woods National Monument, in California, 128.14 acres of land.

Chamois Disappearing.—The serious scarcity of chamois in the mountains of Savoy is laid to the war that, by raising the cost of living and increasing the gun-owning population, is responsible for new activity in hunting.

Branded Fruit.—Trade-mark branded oranges and grapefruit are in especial favor in New York. The electrical branding machine has now been so perfected that it will even brand tomatoes without bruising them or breaking the skin.

Ants That Eat Flowers.—A new type of ant, large, vicious and prolific, is playing havoc with the flower industry of the Italian Riviera. Horticulturists are required to report the appearance of this pest immediately and to take prescribed steps for its destruction. The ants are supposed to have been introduced from the Argentine.

Fur-Seal Shipments.—Last season up to September 15th, 11,260 fur-seal skins and 2614 gallons of seal-blubber oil were received in the United States from the Pribilof Islands, and 11,291 sealskins came from the islands of St. Paul and St. George; there were also shipped 228 gallons of seal-blubber oil, which was used for processing the skins.

Hand-Shaking and Nerve Breaking.—After his hand-shaking tour of Canada, the Prince of Wales could scarcely move his arm for days. A health expert states that the American custom of hand-shaking contributed toward the deaths of Roosevelt and Caruso and is responsible in part for Woodrow Wilson's ill health. "It breaks down the nerve system and invites disease," he says.

A Drive on the Prairie Dog.—In Niobrara County, Wyoming, prairie dogs infest 200,000 acres of farm land, each dog means a loss of more than $1 a year The Biological Survey is cooperating with landowners to clean up these colonies of pests, in one such clean-up 99 per cent of the animals were destroyed. Free bait is furnished for government land, and county commissioners give financial help in the smaller sections.

Back to the Hour-Glass.—A miniature "hour-glass" is now being used to time the telephone conversation Its upper compartment exhausts itself of sand in just three minutes; with one eye on the glass, the telephone user sees when the time is almost up, and can speed up his business accordingly, so that the talk may be finished within the specified three minutes of the long-distance call.

Palaces a Drug on the Market.—The great mansions that dot Central Europe, the former homes of departed royalty and nobility, are presenting something of a problem There is no money to be spared for keeping these as historic souvenirs, or for turning them into museums and art galleries as France and England have done in some cases. It seems likely that they may be used as quarries from which the peasant may dig stones to construct his humble cottage

Depositors To Be Finger-Printed.—All postal savings depositors must now be finger-printed, this supplements the present method of identification and safeguards both the paying postmasters and the depositors. The system was inaugurated on December 15th, and the prints are taken whenever an account is opened or interest or principal paid Care is taken to disabuse the minds of depositors of any connection between this procedure and criminology, those who already have accounts will register their finger-prints in the first transaction following the installation of the system

Paleolithic Religion.—The cave man buried his dead with as solemn religious rites as any in vogue today Such is the conclusion of Prof. Mainage of the French Catholic Institute, from his painstaking studies of relics and ethnological records. Furthermore, he is convinced that their religion was not basically different from ours, and that the latter is merely an evolution of the former. The tombs and carvings reveal nothing in common with animism or totemism, although the cave man's belief undoubtedly accepted a plurality of gods, from which the idea of one supreme being later emerged. Prof. Mainage's investigations, while pointing to the evolutionary nature of religion, throw no light on the origin of the monotheistic concept.

Civil Engineering Notes

The Queenston-Chippewa power development did its first work on December 29th, a 55,000-horsepower unit being started on its trial runs at that date. It was connected with its load about a week later, at time which a second unit of similar capacity went into its trial period.

A Mountain of Sulfur.—Attention is being directed to the existence of an island, Vanua Lava, in the New Hebrides Condominium, which is literally a mountain of sulfur, 1600 feet high and perhaps as much as 100 square miles in base. The material of the mountain is 90 per cent pure sulfur and the balance ash. It was formerly known, but in the uncertainty arising from conflicting administrative claims and conflicting concessions it was practically forgotten. Steps are now being taken to work it.

Use of Gas Masks in Railroad Tunnels.—The annual report of the Director of the Bureau of Mines for the fiscal year ended June 30, 1921, states that an investigation of gas masks for use of train crews in railroad tunnels was completed during the year Results of the tests are being published by the Bureau of Mines in a technical paper entitled, "Tests of Gas Masks and Respirators for Protection from Locomotive Smoke in Railroad Tunnels, with Analyses of Tunnel Atmospheres," by A. C. Fieldner, S. H. Katz and S. P Kinney A small mask was devised that fits conveniently into a coat pocket, and in actual service with locomotive engineers and firemen was found to last two to six months before distasteful gas penetrated.

Ice in Hydro Intakes.—In response to a prediction that ice jams would prove a serious problem in working out power development schemes, a plan for heating the dams, valves, and gates of electricity generating plant slightly above freezing point in order to keep them free from ice was outlined before the International Joint Waterways Commission in session at Ottawa in November A new type of turbine, which the Ontario Hydro-electric Commission proposes to use in the scheme was described by F H Rogers of Philadelphia. The electrical engineer to the Railway Commission, said that, in addition to heating the dams and gates, the machinery within the power plant also would be kept at a temperature above freezing point, thus eliminating any ice formation

Trans-Zambesi Railway Completed This Year.—Satisfactory progress is being made with the Trans Zambesi Railway reports the *London Times* correspondent at Beirut, Nyassaland, East Africa. Probably it will be completed well before the end of the year to the southern bank of the Zambesi, opposite Chinde, where passengers and goods for the Nyassaland Protectorate will be ferried over to the Central African Railway pending an extension of the line up the southern bank of the Zambesi to Muturara, where borings are now proceeding for the foundation of a great bridge to link up Beira with Blantyre direct. Construction of the line from Luchenza (south of Blantyre) direct to the southern end of Lake Nyassa, it is said, will be undertaken as soon as transport material is available by the Trans-Zambesi Railway.

The Waterproofing of Irrigation Canals is dealt with at some length in the Punjab Irrigation Technical Blue Book No. 20 by Mr F W Woods. Commenting on the report, *Indian Engineering* says "Mr Woods' conclusions may be said to be pessimistic as to the value of all the remedies which have so far been the subject of experiment. The mileage of any great irrigation project in India, of canals, distributaries and water courses, is enormous; the cost of waterproofing to any great extent would be enormous also; and the lasting effect of any of the materials is questionable. The percolation, moreover, is not very excessive, and inasmuch as it can generally be adequately dealt with by means of surface drainage, it seems to be time that the experiments should for the present cease. This does not mean that the subject should never be revived. There may always be special localities where action is needed, and circumstances in the course of time may alter the whole position of affairs. But as far as the trials have progressed, and taking into consideration the evidence afforded both in India and elsewhere, the prospects of waterproofing canals on a large scale are distinctly unfavorable."

Mechanical Engineering Notes

Cleaning Large Gears, up to 30 feet in diameter, to remove the glass or silica and the mineral oil left on them by the grinding operation was formerly a two-day job for two men. A pit and roller bearing arrangement was installed whereby the gears might be hoisted upright and sprayed with a chemical solution from a hose while in rotation. The cleaning is now completed by one man in one hour

Parabolic Milling Cutters.—In order to make the cutting tooth of uniform strength throughout its length, the shape adopted in a cutter recently put out is that of a parabola, slightly modified at the small end The number of teeth for the entire circumference of the cutter is then more nearly that in the usual fine-tooth cutter than in the coarse-tooth models, so that the most effective chip thickness per tooth will be attained without excessive speed

Two Operations in One.—The two wrist-pin holes in the opposite sides of an automobile cylinder look very much like two separate grinding jobs. A special double headed grinder with separate grinding heads carried on the same wheel slide has just been put out to make them one, however It is also available for a variety of jobs that involve the grinding of holes in opposite ends of long pieces not conveniently handled by means of a single long wheel spindle.

Belt Tension.—A simple and fairly accurate method of determining this without recourse to a dynamometer test and without in any way interfering with operation is described in a recent issue of *Machinery* by N G Near The formula used is $S = WL^2/8T$, where S is the sag in feet W the weight of the belt in pounds per cubic inch L the span of the belt, in feet and T the cross-sectional tension of the belt in pounds per square inch Ordinarily W and L would be known so that it would be necessary merely to measure S and substitute in the formula

Pneumatic Collecting and Conveying Systems seem rather less well known than their merits would justify In many industries there are operations or processes which litter machines or floors with refuse material or which throw dust fumes or smoke into the air of the room. The collection, conveyance, reclamation or removal of these by-products frequently develops a problem in efficiency and cost that taxes the ingenuity and patience of the engineer Pneumatic dust-removal, conveying, exhaust and air-washer systems are a few of the many possibilities inherent in the use of air for this sort of thing and the cost and satisfactory operation are often surprisingly favorable.

Swaging, a process little known to the ordinary machine shop a few years ago has recently come to occupy a place of considerable importance. For tapering, pointing and graduating tubes, rods and bars in the manufacture of many delicate instruments such as those for the optician, the jeweler and the dentist; and in many other directions, it is fast taking the place of older and less satisfactory methods of attaining the same shapes. It is claimed by its exponents that it kneads the fibers of the metal closer together and insures a tougher stronger and more elastic product than any competing process. However this be, it is certain that new uses for swaging are being found daily, and that it offers large opportunities for economy and improvement of product.

Electricity in the Steel Mill.—The electric plant-railroad is no longer a novelty nevertheless some of its applications are comparatively new and others involve difficulties of a sufficiently formidable character to bring forth the engineer's best efforts. When the current is carried on a third rail it is ordinarily found that anything in the way of an adequate protection to the workman will act also as a protection to the rail against short-circuiting by contact with extraneous bodies. An exception is in the case where the miniature electric transportation line is set up in the steel mill, where guard strips which might be altogether protective to passing workmen would be demolished and the third rail severely damaged by hot metal falling on the rail in good-sized quantities. This hazard, however, can be overcome by the use of the underneath contact, plus proper insulation, which makes the third rail [illegible] practicable in these trying circumstances. A system of the sort is described in *Iron Age* for December 29th.

Patents and Trade-Marks Notes

Language in a Patent.—There are few documents in English which require a more precise and well-chosen form of expression than does a patent. In fact, a patent claim, under the United States Patent Practice, is one of the most difficult expressions properly to formulate in the English language. Nevertheless, there is no hard and fast rule as to the use of the language which must be employed, nor of the kind of technical terminology to be used. This fact was recently reiterated by the United States Circuit Court of Appeals for the Seventh Circuit, in Rajah Auto Supply Co. vs. Belvedere Screw & Machine Co., et al. (275 F 761), in which the Court held that a patentee may define his own terms, regardless of common or technical meaning, and his definition of words, phrases and terms will be accepted by the Court.

Consent Decree Constitutes an Agreement.—The United States Circuit Court for the Second Circuit, in a recent decision has declared (Wilson, et al., vs. Haber Bros., Inc., 275 Fed 846), that a Consent Decree is an agreement of the parties and is to be interpreted as an agreement, and consequently a suit for infringement of a design patent and copyright, resulting in a Consent Decree, by which the defendant specifically agreed that the Court should declare a trade-mark and copyright "good and valid in law," estops the defendant from asserting the patent and copyright to be invalid. The Court expresses no opinion as to the propriety of copyrighting the subject-matter in issue, i.e., the "Kewpie" doll, but says that the defendant was at liberty to estop itself from contesting validity, and that by permitting the Consent Decree to be entered it had done so.

Loss of Trade-Mark Rights.—Trade-mark rights may be lost through abandonment, laches, acquiescence, misrepresentation or fraud, and any one of these causes may be interposed as a defense to an action for infringement. The question of intent on the part of the owner of a trade-mark determines whether the trade mark has been abandoned or not, although sometimes an intent to abandon will be inferred from the acts of the owner of the trade-mark, and the circumstances. In Saxlehner vs. Eisner & Mendelsohn Co., 179 U. S., 19, the Court said: "To establish the defense of abandonment it is necessary to show not only acts indicating a practical abandonment, but an actual intent to abandon. Acts which, unexplained, would be sufficient to establish an abandonment may be answered by showing that there never was an intention to give up and relinquish the right claimed."

Expanding Limited Patent Claims.—Attention is called to a recent decision of the U. S. District Court for the District of Connecticut in the case of Menzer vs. Kenworthy, 275 Fed 240. In this case the court adds another to a relatively long list of precedents showing that while the claim of a patent may be limited in language to the exact construction shown and described in the drawing and specifications, yet if the state of the art warrants the court in so doing, such claim will be interpreted to protect the patentee against one who, while not following exactly such construction, nevertheless uses a mechanical equivalent. In this particular case the machine of the patent, a metal blocking machine, embodies a carrier and a yoke for the blocking belt, comprising a pair of standards and a pair of side members, while in the defendant's machine the carrier had but a single standard and the yoke had but a single side member. The claim at issue specifically describes the construction as one in which there is a pair of standards supporting the yoke. In finding that the defendant had infringed, the Court stated: "Being satisfied that the invention is substantial and meritorious, the strict interpretation insisted upon should not be put upon the claim. It is immaterial, in view of the state of the art, whether one or more standards are used, or whether a yoke or its equivalent—a rigid frame member—is pivoted to one or more standards, the same operations and the same functions result. Neither need the height of the standard or standards be considered, as long as the standard or standards and the yoke or its equivalent are located on diametrically opposite portions of the block." The Court thus followed a long line of cases beginning with Winans v. Denmead, 56 U. S., 330, wherein apparently limited patents have been interpreted, but where the state of the art warranted it to cover the real invention and thus afford to the patentee that protection which the law contemplated.

Electrical Notes

Summaries and Excerpts from Current Periodicals

Renewable Fuse Plug.—An American concern has been working on the problem of a renewable plug fuse for some years past—a plug fuse so simple that anyone could refill it and put a line back into operation It is of the Edison type and renewable, for use on circuits of 125 volts with ratings from 3 to 30 amperes. The fuse consists of three parts, the body, the cap, and the refill. The cap and the body are of heat-resisting molded insulation. The refill is stated to be an ingenious little cartridge, properly vented for the emission of the gases when the element vaporizes, and has the rating of this element stamped on both ends so that it is always visible through the aperture in the cap, regardless of how it is inserted in the body

Electrical Progress in Sweden.—According to the *Swedish-American Trade Journal*, while the available statistics for 1917 give the electrical acreage of cultivated land in Sweden as 6.4 per cent of the total arable land of the country, the corresponding statistics of 1920 show about one-third of the cultivated ground to be electrified. Hydroelectric power plants abound in Sweden, in large and *small* units, indeed, there is a growing tendency for inhabitants of various regions to club together and install turbines in the rivers in order to supply local needs. Electric cooking is growing in popularity in Stockholm, and the central station company is planning reduced rates for this service.

Electrification of Japanese Railways.—More than 2000 miles of Japanese railways have been designated for electrification by the commission having this matter in hand, according to the *Japan Times and Mail* This mileage is classified as follows 1. All sections in the suburbs of cities where there is a heavy railway traffic, 186 miles. 2. Sections of high gradient where there are many tunnels and also those where abundant water power can be utilized, 871 miles. 3. Sections where shortening of the line is required and where water power can be utilized, 395 miles. 4. Sections where increase of transportation capacity and shortening of the line are required, 295 miles. 5. Sections where available water power can be utilized, 265 miles. 6. Sections where increase of carrying capacity is required and where coal can be obtained at a low price, 146 miles.

Kites and High-Tension Cables.—From various parts of the country come reports of serious and even fatal accidents due to the flying of kites with fine wire in place of the usual string. It appears that youngsters, in their desire to obtain higher altitudes for their kites, substitute fine wire for heavy string. There are several recent instances of such kites and fine wires coming in contact with high-tension wires or cables with unfortunate results. From California, for example, comes news of this tragedy. One man was killed in Los Angeles, one boy crippled for life, and two others so badly burned that they were confined to the hospital, because one progressive youngster used a metal string for his kite. We learn that a boy in Flint, Mich., was killed last August in a very similar manner It might be well to impress on youngsters the danger of using fine wire of any kind in kite-flying.

A Low-Candlepower Electric Lamp.—A solution of the very low candlepower electric lamp problem is believed to be afforded by a lamp recently introduced in England. The outward appearance of this new lamp is much the same as that of the usual British electric lamp, and is fitted with a standard bayonet clip base. However, an examination of the inner details of the lamp discloses the fact that it is of the electric discharge or ionic bombardment type. The bulb contains a small quantity of neon gas, and there are two metal electrodes placed a short distance from each other and between which the discharge takes place. The outer metal electrode or cathode is of wire, wound in beehive shape, and when the lamp is energized a luminous haze appears round this cathode and provides the source of light. The light is somewhat orange, of a pleasing color, and being rich in red and yellow rays is well visible at a distance. The lamp is obtainable in 200 to 220 volts, and 221 to 250 volts. The energy consumption is 5 watts.

New Tungsten Arc Lamp.—From Holland comes word that a lamp works has developed a new type of tungsten arc lamp. In this new lamp an arc discharge takes place between small tungsten spheres in an atmosphere of rare gas. The lamp has also a great advantage in that it can be run on a 200-volt alternating current circuit, and except for a series resistance, no auxiliary apparatus is necessary The voltage on the arc itself is about 25 volts. In order to ensure the striking of the arc a third electrode is mounted in the lamp and a high resistance in the cap or base of the lamp connects this third electrode to one of the leading in wires. The material and the form of this third electrode have been chosen in such a way that a glow discharge sets in first between it and the electrode next to it, so starting the discharge between the small tungsten spheres. A funnel-shaped screen is provided, on which the evaporated and spattered tungsten is deposited in order to prevent the blackening of the bulb. Lamps with a current consumption of 1 and 2.5 amperes are now available, larger sizes being in preparation Experiments with direct current lamps are now being made

Carrier Current.—A demonstration of the application of "carrier current" communication from a moving car was recently made and represents an important advance in electric train operation The system was developed to provide better means of communication between the locomotive and caboose of long trains and between trains and substations or waiting rooms of electric railroads. The operation of the system according to *General Electric Review*, is as follows The trolley wire, carrying current to the electric locomotive or trolley car is used as a carrier of telephone communication by means of another current of different frequency, which is superimposed on the wire and travels along with it. This "carrier current," properly modulated by speech, is drawn off by special apparatus to a telephone instrument. At another point along the line, however, the message speeding along the trolley wire may be transmitted short distances through the air and made to energize an instrument in a substation or waiting room, becoming audible through a receiver In effect, the system transmits messages electrically partly over a wire and partly through space In tests engineers have not only been able to telephone but to operate relays, light lamps, and start and stop one car from another car at a distance of a mile and a half. Communication by this means has been effected successfully over distances of from 40 to 60 miles.

Electrolytic Protection of Steam Boilers.—A method said to be successful in protecting steam boilers against their two greater enemies, corrosion and boiler scale, is described in a recent issue of *Siemens Zeitschrift* Careful investigation of corrosion on boiler bottoms water tubes and condensers proved, according to W Philippi, the author, that electrolytic action was the cause of these damages. As a remedy a metal of higher e.m.f., like zinc, has been connected electrically to the boiler to create a counter e.m.f. to compensate for the corrosion current. But this method did not always give complete satisfaction, as it was impossible to regulate the current. An externally generated direct current applied through electrodes into the boiler was found to be a perfect remedy In fact, by doing this the small but constant generation of hydrogen along the boiler walls will also effectively prevent the formation of boiler scale. A direct current voltage of from 10 to 20, at a current density of about 2 milliamperes per square foot, was found to be most effective. A small motor-generator of 6-kilowatt capacity may supply a battery of 18 boilers, each of which may have four protective electrodes. A small resistance in series with each electrode circuit permits of suitable regulation of the voltage. Ordinary wrought-iron gas pipes are used as electrodes. Experience with this protection, extending now over several years, surpassed all expectations.

Wild Life Notes

Cat May Use Claws in Defense.—Boston woman sued for damages sustained in an attempt to separate her dog from a grocery-store cat. The Supreme Court held that the woman voluntarily submitted herself to danger and had no recourse in law

Mastodon Ivory Sought. — Genuine ivory is exceedingly scarce and many hunters have left Seattle this past summer to prospect the Yukon and Norton Sound tundras for mastodon tusks. Another source of supply is the Behring Sea walrus and narwhal

American Museum Acquisitions.—Two treasured additions to the American Museum are an incomplete skull of the European bison or wisent, and a fine skull and jaws of the urus or extinct wild ox of Europe which is probably the remote ancestor of our domestic cattle Both these came from the Cambridge (England) Museum of Zoology

Steel Jaws Are Cruel.—One fourth of the animals caught by steel traps are worth less 15 per cent. escape by chewing off a leg Many are eaten by other animals all suffer lingering torture. The American Humane Society offers prizes aggregating $800 for the best essays acquainting the public with this cruelty and showing how it may be remedied

Antivivisectionist Converted.—M E H Baynes, indignant at the wanton cruelty imputed to the vivisectionists made careful investigation In his article 'The Truth About Vivisection in the *Woman's Home Companion* he declares that antivivisectionist propaganda is deliberately misleading that the laboratories handle their animals with the utmost kindness and that their work has furnished knowledge of the highest value in diphtheria antitoxin asepsis antityphoid vaccination and the transmission of yellow fever

The Bite of the Gila Monster.—*Natural History* has an instructive little article on the Gila monster Authorities differ as to the deadliness of its bite but no really authentic case of human death from this source has been forthcoming The poison is fatal but it seems that the animal is unprovided with means for ejecting it the glands are in the under side of the mouth imperfectly connected with the teeth and as Dr Leo Loeb points out, liquids won t flow uphill One Gila monster was adopted as a playfellow by a five year-old girl and never offered to bite her another after being safely handled by a museum attendant for a year inflicted the worst bite on record but the man recovered The poison seems generally to be wiped off before it can enter the wound

Passing of the Sea Horse.—That curious little fish *Hippocampus hudsonius* commonly known as the sea horse, has been growing scarcer in the northern ranges of the Atlantic coast waters during recent years The gradual extinction of this picturesque animal is believed to be due to the heavy fuel-oils used in sea going vessels. The thousands of gallons which are wasted into the sea cause the death of the small crustaceans which form the sole food of the sea horse So serious has this menace become that it is threatening the shellfish and other inhabitants of our shore waters which are of economic value. With the constantly increasing number of oil burning ships, it is evident that unless this needless wastage is abated the consequences will be disastrous. In fact, legislative action is a desideratum right now

A Baby Tapir.—A Maylayan tapir born recently in a London zoo' is attracting attention partly by reason of its being the first recorded birth of these animals in captivity but mainly for the remarkable instance of protective coloration which it exhibits. It is strongly striped and spotted with white on a black background—a feature making it extremely invisible in the broken lights and shadows of its natural habitat, the jungle The mother on the other hand, is totally different in her markings She is jet black over the entire body with the exception of a broad white patch extending over her back and haunches to her belly The explanation of the change in markings which takes place as the tapir gets older is found in its change of habits. When the animal grows it leaves the recesses of the jungle and frequents shallow streams or dried river courses where boulders are plentiful This adaptive change of striped markings to expansive patches enables it to be safely concealed in its new surroundings.

Radio Notes

A Review and Commentary on the Progress in This Branch of Rapid Communication

A New Crystal Detector is described in a French patent granted to R. Pedegurt. The new detector is one in which the known properties of galena are employed in a novel manner. The device consists of a container partly filled with mercury and hermetically closed by a plug of insulating material through which pass two terminals on the inner ends of which are carried galena crystals, which dip into the mercury.

The Loud-Speaker is virtually the backbone of successful radio-phone reception. When wearing head receivers one is apt to hear too many of the disturbances and howls existing in the various circuits, especially if the signals are brought up loud. However, with the loud-speaker in operation it is generally possible to hear the voice or music loud and clear above the parasitic sounds, which makes the radio-phone service all the more popular and enjoyable.

Transmission Strength.—From a recent issue of *Radio Review* we learn of the investigations carried out to measure the strength of radio signals sent from Lyons and Nantes, in France. Reception at ranges of 7000 to 10,000 kilometers were made, in which comparisons were drawn between day and night receptions. Signals were found to be weaker in the Pacific than in the Indian Ocean, and the audible range of signals was not symmetrical.

Operation of Modulator Tube.—According to E. S. Purington, writing in Scientific Paper No. 423 of the Bureau of Standards, the most satisfactory method of modulating the output current of an electron tube generating circuit is by variation of the operating plate voltage. A study is made of: (1) Operation of the modulator tube as an aperiodic power amplifier; (2) the actual load impedance of a tube acting as an amplifier; (3) imperfections of the audio choke coil due to its reactance; (4) the audio impedance of parts of the generating circuit, and (5) the presence of electromagnetic energy in the radiator unit. The signal strength under conditions of no distortion, using a receiving set with square law of reception, is proportional to the difference between the peak radio power and the minimum radio power in the transmitter radiator unit.

Supersensitiveness and Distortion.—The extent to which the sensitiveness of the regenerative receiving set and two-step amplifier may be raised is nothing short of marvelous. However, there are certain critical adjustments where the utmost sensitiveness is obtained, but only at the expense of serious distortion and howling. Indeed, it is aggravating, under such circumstances, to be receiving radio telephone music and talks amid such noises that good reception becomes quite impossible. Thus, with a 60-foot piece of wire serving as the aerial one may be able to pick up Pittsburgh radio-phone broadcasting station in the vicinity of New York, but only by means of maximum regeneration and two-step amplification. What is gained in loudness is sacrificed by clarity, so that in the long run nothing is really gained. And here, precisely, is where the radio frequency amplifier comes into use, for it can amplify the signals themselves before they are brought to the detector to be rectified.

The Negative Resistance Valve.—Considerable interest has been aroused by the so-called "Negatron," which, as its name implies, is a negative resistance valve. According to *The Electrician*, this valve is used as a continuous wave generator and has found a wide commercial application, particularly on board vessels of the mercantile marine. More recently much has been heard of magnetic control thermionic valves, as vacuum tubes are called in England, for producing oscillations, although it is too early to say if they will find a practical application. The Admiralty carried out a great deal of very valuable work in connection with high-power vacuum tube transmitters. They successfully used [illegible] for supplying the [illegible] of [illegible] without the use of rectifying [illegible]. The installation at [illegible] was very [illegible]. It seems likely that the [illegible] will lead to a very [illegible].

Radio Taste Reception.—In a recent issue of *Proceedings of the Institute of Radio Engineers* there are described certain experiments made to determine the feasibility of reception of radio telegraph signals by the sense of taste. Silver electrodes were used, one of which made contact with the inner part of the upper lip of the operator and the other with the tip of his tongue. With a direct-current circuit it was found that the observer could detect a potential difference across the electrodes of 0.4 volt. A potential difference of 2.0 volts was considered sufficient for the transmission of signals. With an alternating-current circuit these values were not very much different, but the element of fatigue did not seem to be so noticeable and the taste sensation appeared to be more continuous. In actual experiments using radio reception and four-stage amplification, it was found possible to detect signals the audibility of which in the detector circuit was 500 or more. It was also found possible to tune in a station by noting when the intensity of the taste sensation was a maximum. But for messages to be read the speed must not be greater than 10 words a minute.

What Makes Radio Work?—All kinds of explanations have been offered as to how the radio waves travel from the transmitter to the receiver. In a recent lecture given before the Royal Society of Arts, Prof. J. A. Flemming, the well known radio authority, gave a new explanation. After a discussion of the propagation of electromotive waves, Dr. Flemming proceeded to explain that the presence of the highly conducting layer in the upper regions of the atmosphere, in which the component gases are hydrogen and helium, is probably due to electrified dust which comes to us from the sun, from which it is repelled by the radiation pressure against the gravitation attraction. He said that this dust came from the sun with enormous velocity and entered the higher levels of the atmosphere and rendered it conducting. This conducting layer guides the radio waves round the earth and prevents them from escaping into space. The lecture concluded with some remarks on the effect of recent physico-mathematical speculations on relativity, and especially the agnostic view now taken as regards the existence of a space-filling ether, on the theory of radiotelegraphy. It is clear that space is not a mere vacuum, but has remarkable powers of storing and transmitting energy, but modern physical and astronomical discoveries have rendered necessary great modification in our ideas regarding the structure of space or the ether and no theory of radiation has yet been propounded which satisfactorily explains all the known facts.

Transatlantic Radio Transmission by Amateurs.—In another part of this issue appears an article on the recent transatlantic transmission experiments by amateurs. The list of American amateur stations that were copied by the American observer station in Scotland is as follows:

1AFV, Salem, Mass., C.W., 200 meters, 1TS, Bristol, Conn., C.W., 200 meters, 1RU, West Hartford, Conn., C.W., 200 meters, 1DA, Manchester, Mass., C.W., 200 meters; 1AW, Hartford, Conn., Spk., 210 meters, 1BCG, Greenwich, Conn., C.W., 230 meters, 2BML, Riverhead, L. I., C.W., 200 meters; 2FD, New York City, C.W., 200 meters; 2FP, Brooklyn, C.W., 200 meters, 2OM, Ridgewood, N. J., Spk., 200 meters, 2EL, Freeport, L. I., C.W., 200 meters; 3DH, Princeton, N. J., C.W., 210 meters, 4GL, Savannah, Ga., C.W., 200 meters, 3BP, Newmarket, Ont., Spk., 200 meters, 8DR, Pittsburgh, Pa., C.W., 200 meters; 9KO, St. Louis, Mo., Spk., 200 meters, 9AW, Toronto, Ont., C.W., 200 meters; 1ZE, Marion, Mass., C.W., 375 meters; 2ZL, Valley Stream, L. I., C.W., 325 meters; 8ZO, Parkersburg, Pa., C.W., 360 meters; 5ZA, Blackwell, Oklahoma, Spk., 375 meters; 6XH, Stanford U., Cal., C.W., 375 meters; 7ZG, Bear Creek, Mont., Spk., 375 meters; 8XK, Pittsburgh, Pa., C.W., 375 meters; 9ZY, Lacrosse, Wis., C.W., 200 meters; 9ZN, Chicago, Ill., Spk., 375 meters; 9XI, Minneapolis, Minn., C.W., 200 meters.

CLASSIFIED ADVERTISEMENTS

The Market Place for the Small Advertiser

Advertising in this section is $1.00 a line. No less than five nor more than twelve lines accepted Count seven words to the line All orders must be accompanied by a remittance. Advertisements for insertion in June number should be received by April 20th

AGENTS WANTED

$15 DAILY AND MORE for Men and Women Agents selling new guaranteed household necessity Women go wild about it. No experience. Permanent business New agent sold 160 in two days (profit $[illegible]) Write for proof W J Lynch, Box 718, Springfield, Ill

AGENTS, 500% profit. Free sample. Lowest priced Gold and Silver Sign Letters for stores, offices, automobiles. Large demand. No experience necessary $[illegible] to $[illegible] a week easy Exclusive territory Acme Letter Co 2800 A Congress St., Chicago

AMBITIOUS WRITERS

AMBITIOUS WRITERS send today for free copy America's leading magazine for writers of Photoplays, Stories, Poems, Songs. Instructive, helpful. Writers Digest, 608 Butler Bldg., Cincinnati

AMERICAN MADE METAL TOYS AND NOVELTIES

MANUFACTURERS WANTED on large or small scale for production of metal toys and novelties Toy soldiers, cannons, machine guns, cowboys, indians wild animals, whistles, bird whistles, race horses baseball players, paper weights, match holders, automobile radiator ornaments, souvenirs, advertising specialties, and hundreds of other things. No experience or tools necessary Hundreds and thousands made complete per hour Bronze casting forms furnished to manufacturers own plate with outfit from $6.00 up. We buy these goods all year paying fixed prices. Contract orders placed with manufacturers. An enormous business is offered to industrious men this year with an excellent opportunity to enter this open field. Write us only if you mean strictly business. Catalog and information free Metal Cast Products Company, 1696 Boston Road New York

FOR AUTO OWNERS

FORD Car Repair Book sent free This complete well illustrated, valuable book explains in a simple way the Causes and Cures of Over-heating Repairing Ford Timer; Curing Piston Ring Troubles Carburetor Adjustments and Repairs Connecting Rods; Transmission Troubles Care and Repair of Rear Axle Keeping Axle Grease Leaks; also covers practically every other phase of Ford Car Repairing Send the coin for three months trial subscription and get the valuable repair book free Ford Owner and Dealer Magazine 300 Montgomery Bldg., Milwaukee, Wis.

AVIATION

THIS is your chance to become an airplane expert by home study Real airplane parts and small machine supplied with course for practical work Factory and flying instruction arranged for Employment service. Write, Leslie Coombs, Chief Engineer Central Airplane Works, 503 Windsor Ave Chicago.

BOOKS

ORIGINAL "Master Key, 36 full course lessons $5.00. Magical Art $10.00. Marvelous new music sheet with two latest songs. All Babies Look Alike to Me "Thy God" 30c. Catalogues 2c. Sovereign Co 160 Sycamore St., Buffalo

BUSINESS OPPORTUNITY

STOP DAILY GRIND start silvering mirrors, auto headlights, tableware etc. Big money Earn while you learn. Easily mastered PLANS FREE Make a start for yourself today Write Clarence Sprinkle Dept. 113, Marion Indiana.

YOU CAN have a business profession of your own and earn big income in service fees. A new system of foot correction readily learned by anyone at home in a few weeks. Easy terms for training openings everywhere with all the trade you can attend to. No capital required or goods to buy, no agency or soliciting Address Stephenson Laboratories 28 Back Bay Boston Mass.

GRANDFATHER clock works, $5.00 Build your own case, instructions free, make good profits selling your friends. Clock works with chimes for old or new cases Write for full particulars. Clock Co Ruffner St. Philadelphia, Pennsylvania.

PARTIES to take out foreign patents on timing device which is valuable in every house U S. patent has been allowed, Very liberal interest to right parties. You handle your own money no chance to lose. J M Terrance, Norcross, Ga.

BE MORE SUCCESSFUL buying selling trading Master dealer system makes real estate easy safe profitable. Guaranteed or costs nothing Interesting booklet explains all. Send today Instruction Dept. Stephens Realtor Service, Muncie, Indiana.

SCHEMER MAGAZINE Alliance Ohio 40-page monthly printable profit schemes one subscriber making $25,000 from three, another $10 000 from one Try your luck Year only $1.00 three months 25c Name free

OLD MONEY WANTED

$2 to $500 EACH paid for hundreds of Old or Odd Coins. Keep all old money You may have valuable coins Send 10c for Ill's Coin Value Book 4x6. Get posted. We pay cash Clarke Coin Co., Ave 61, Le Roy N Y

EXPERIMENTAL RUBBER WORK

WE DO experimental compounding vulcanizing testing; chemical analyses; develop your rubber ideas, processes, inventions. Let us advise you. Consult us. Kent Rubber Laboratory Consulting Engineering Chemists, Box 126, Kent, Ohio

FOR INVENTORS

MODELS MADE—SUPERIOR WORKMANSHIP All kinds of experimental work done Prices very reasonable. Hagerstrom, 146 Lehigh Ave Cranford, N J 45 minutes from New York City

PRACTICAL instructions to inventors and patentees written by the manufacturer and inventor Charles Hunnicutt, covering every problem relating to inventions Experience has shown the best means of patenting manufacturing and marketing inventions Written in the plain style of an honest man No patent lawyer solicitations For sale by Thos Cooper Exclusive Agent 1201 North Capitol St Washington D C $1 prepaid. Satisfaction or money refunded

EXPERT and confidential service in machine design patent-office sheets, advertising cuts, labels, trade marks Free circular Bank references. The Engineering Service Co., Canton, Ohio.

INVENTOR and Manufacturer Let us be your machine shop. We make models build special machinery tools, dies and manufacturing We have a modern daylight factory with precision machinery Send blue prints or sketches for estimate. Victor Engineering & Mfg Co 2624 W Chicago Ave Chicago, Ill

FOR SALE

DON'T buy a Bicycle Motor Attachment until you get our catalogue and prices. Shaw Mfg Co Dept. 8A Galesburg Kans

SELL YOUR property quickly for cash no matter where located Don't pay big commissions. Particulars free Real Estate Salesman Co. Desk A Lincoln Neb.

SAVE 50%. Order one of our recovers for your Auto Top Write for samples. Atlantic Auto Top Co 2810 Atlantic Ave Atlantic City N J

HOW To Build Beautiful Homes At Small Cost. Read My Book on the Twentieth Century Building Materials Price One Dollar Peter de Linde Zion, Ill

DRAWING INSTRUMENTS all in rules Highest quality lowest prices. Direct from importer circulars free Automotive Engineering Co Castle Hall Indianapolis, Ind

BUY your cigars direct. Fifty La Columbias Prepaid $1.75. Agents wanted. Havana Smokehouse. Homeland, Georgia

PATENT RIGHTS on artificial bait described on page 270 for sale outright or on royalty basis. Bait swims and dives with lifelike movements of the tail Many other important advantages. John Frame, care of Penobscott Coal and Wharf Co Bucksport, Maine.

PATENTS No. 1 380 664 U S. and No 208 806 Canadian for sale outright or on royalty basis A valuable article in universal demand Manufacturing cost small It will pay you to investigate M O M Neely Tulare Calif.

WILL sell non refillable bottle patent at worth while price. For more details write to D G Abels Chehalis, Washington

MAIL ORDER METHODS

$50 A WEEK evenings home—I made it. Sample article and plan 25c. Booklet for stamp tells how also you can earn $15 a hundred stamping names on key checks. Sample and instructions 25c. Alexis Scott, Cohoes, N Y

MANUFACTURING

MANUFACTURING light, metal articles, brass work etc., brass railings, experimental work models, all kinds of grain tryers, gear cutting dies and stamping Circular free. Kansas Metal Specialties Co 1622 Wyandotte Street, Kansas City, Mo.

WILL arrange to manufacture and sell on liberal royalty basis, patented or patentable inventions pertaining to railroad cars or locomotives. Any tool or apparatus that will cut costs will interest us Send us your prints and description Charles Lee, Spring Lane Chestnut Hill, Pa.

MUSICAL

CORNETISTS Trombonists, Baritonists, Hornists, Saxophonists, Clarinetists, who have trouble with High or Low Tones, Weak Lips, Fast Staccato, Triple Tonguing Tone Transposition Jazzing etc. should send for *Free Pointers* Mention Instrument. Virtuoso School Buffalo N Y

SONG WORDS wanted: Composed and published on 50-50 basis. No fee asked if you fail Universal Song Publishers, 4647 Winthrop Chicago.

PERSONAL

EXCHANGE cheery letters with new friends! Lots of fun! Send stamped envelope for information of our exchange plan. Betty Lee 28 East Bay Street, Suite 19 Jacksonville Florida.

POSITIONS VACANT

SCIENTIFIC ASSISTANTS Young unmarried college graduates for special scientific work in foreign countries men with B S or C E degree preferred. Salary $1600 to $1900 per annum according to qualifications with traveling and living expenses and opportunity for advancement. Address: Box 187, Scientific American

RESPONSIBLE corporation wants general sales managers to open branch office, manage salesmen $300 to $1,000 necessary expenses to Baltimore allowed if you qualify Address Manager 603 N Eutaw Street, Baltimore, Md

SCIENTIFIC INFORMATION

SUCCESS or Failure! Which is your destiny? Scientific information Success pointers and Personality sketch for 10c and birthdate Thomson-Heywood, Dept. 95 Chronicle Bldg San Francisco, Cal

STAMPS

FREE! Sectional Loose Leaf Postage Stamp Album at the rate of 8 pages each month given with subscription to our monthly Journal Send two-cent stamp for prospectus. United Stamp Co 140 S Dearborn St, Chicago Ill Dept 5

STAMPS 100 China, Egypt, etc. 5c. Album (500 pictures) 3c. Bigger ones 14c, $1 00 $2.25. Illustrated World Catalogue (2 books) for 15c. A. Bullard & Co 446 Tremont St., Dept. 21 Boston Mass.

WANTED

MANUFACTURER to market patented Spring Hold er for Fishing Reels on royalty basis or will sell full patent rights. Now successfully used on Pacific Coast fishing launches. Address C J Anderson Box 964, Fort Bragg California.

SEND us the names of five amateur photographers and receive free Kodak picture of Genl Pershing in France Also include one of your negatives for free sample of print. Phil Landsted, Cape Cottage, Maine.

WE ARE equipped to successfully market a limited number of high class salable specialties, imported or domestic; must be repeaters and out of the ordinary to interest us. Submit samples and details. Kline, Inc., 142 Nassau St. New York.

MACHINE Work Wanted. Wood and metal patterns, stampings, and manufacturing in production quantities. Send us your machine or dope on it. No jobs too large for our capacity Lamb Co., 1300 Franklin St., Detroit, Mich.

Government Activities

Mine-Layers as Life Savers.—As part of the Government's economy program, Navy mine-layers will be used to lay buoys, so Administration officials say

Mosquitoes in the Yosemite.—Malaria-carrying mosquitoes have been found in Yosemite Park, and the sanitary engineers of the U S Public Health Service are doing their best to eradicate them.

Safety First for the Silo.—The Department of Agriculture warns the farmer against entering a partly filled silo until the machine blower has been in action for at least two minutes, the carbon monoxide gas has often caused death Only recently two Illinois farmers were killed in this way It is well also not to wedge the silo doors into place until absolutely necessary

Code Words and the Weather Bureau.—The 4500 weather reports transmitted twice daily by the Bureau total more than 3 000,000 code words annually About 170 station reports are reciprocally distributed over 21 circuits. Thus each day there is placed before the public, the country over, full knowledge of weather conditions in all sections of the United States and adjoining territories

Not All Dusts Are the Enemies of Mankind.—The Bureau of Mines is encouraging the use in coal mines of barriers of certain rock dusts which, when jarred by the explosion of coal dust, scatter and act as a screen for the stoppage of the exploding coal dust The dust waste from slate quarries amounting to about 90 per cent of the entire material mined has been found by the Bureau to be peculiarly adapted to use as a filler in the making of asphalt road surfaces.

Fine Map Work.—For 34 years the U S Geological Survey has been carefully mapping not only mineral features but also the results of topographical surveys valuable from many points of view In this time 3000 engraved maps have been issued and the program will eventually cover all the territory of every State About 40 per cent of this program is completed including all New Jersey Connecticut and Rhode Island and about 90 per cent of New York Several States are cooperating and in 1920 contributed nearly $200 000 to the work.

Petroleum Laws.—The publication of a Bulletin Petroleum Laws of all America' by J W Thompson law examiner is announced by the United States Bureau of Mines. The bulletin includes the petroleum laws of the United States, the several oil producing States Canada, Mexico, and the Republics of Central and South America. The report has been prepared in response to the wide demand for information regarding the laws regulating leases and concessions and the explorations for and exploiting of petroleum in these Republics It is sold at production cost.

Non-Metallic Building Materials.—The Bureau of Mines is studying the technology of cement and heavy clay products and experimenting as to selection of raw materials the economical use of fuel, and problems of transportation basic problems connected with clay burning are being attacked, and phosphate rock, feldspar, slate and potash will also come under scrutiny The object is to accumulate technical and economic data that will enable the many small, scattered plants to develop improved technology so *Chemical and Metallurgical Engineering* informs us, with a view to placing the manufacture of these materials on a basis that will eliminate unnecessary costs and wastes

Gasoline Production.—Statistics compiled by the United States Bureau of Mines show that the production of gasoline throughout the country for the first six months of 1921 amounted to 2 573,548,547 gallons, an increase of 18 per cent over the production for the same period in 1920 Imports of gasoline for the first half of 1921 were 14,-835,056 gallons, or 32 per cent less than the imports for the corresponding period in 1920 A comparison of the consumption of gasoline for the first half of 1921 with that of the same period in 1920 shows that the exports, amounting to 286,564,514 gallons, are approximately the same, while shipments to insular possessions, amounting to 14,861,480 gallons, increased 45 per cent and the domestic consumption 1,906,689,290 gallons, increased by 8 per cent. Stocks of gasoline on hand June 30, 1921, were 750,644,450 gallons, or 49 per cent larger than the stocks a year previous, compared with the stocks of January 1, 1921, they show an increase of 63 per cent.

Notes and Queries

The Notes and Queries column is maintained for the benefit of our readers who desire information on subjects germane to the scope of the paper together with technical formulas and similar information Matters requiring profound research or searches in a library cannot be undertaken In connection with Notes and Queries proper we maintain a Service Bureau which is able in nearly all cases, to supply addresses of manufacturers whose articles have sufficient novelty and merit to be illustrated in the news pages of this periodical Correspondents are requested to write their inquiries in all cases, making the subject of the letter entirely separate from the correspondence relating to patents subscription, books etc. This will greatly facilitate the answering of those questions which in many cases have to be referred to experts The full name and address should always be given. Our full "Hints to Correspondents will be gladly mailed on request All letters are answered by mail and only a very few of them can be printed in the limited space at our disposal

(14400) J L H asks Can the velocity of heavenly bodies be revealed and their motions calculated by the aid of their spectra? 2 In case of a star that was traveling head on to the solar system, would the bands of color of the spectrum be affected or moved in any way and if so, what would be the explanation of this? A. The motion of stars toward or away from the earth is determined wholly by their spectra The motion across the line of sight, which is called its proper motion may be determined by the position of the star after a long interval as compared with its position at the beginning of that interval The right ascension and declination of many stars are slowly changing This would be the real motion, if the star were moving directly athwart the line of vision but if moving obliquely to the line of vision it would not be the real motion It would be but one component of its real motion The component of its real motion which is directly toward or away from the earth is determined by the shift of its spectrum lines toward the violet or the red of the spectrum of the star as compared with the position of the same lines in the spectrum in the laboratory *If a star is coming toward us the frequency of its light is increased by the* amount of its motion toward us. This shortens the wave length of its light and moves the spectrum lines toward the violet and conversely motion away from us reduces the frequency of the light and the lines move toward the red end of the spectrum This is true of all heavenly bodies The side of the sun which is approaching us has its spectrum lines affected as well as those of the side which is turning away from us Thus the velocity of the rotation of the sun is determined So too is the velocity of rotation of a sun spot.

(14401) H H J asks 1 In pumping up automobile tires I have never been able to inflate them to as high a pressure as is shown on the air tank gage (I mean at times when the tank pressure is but slightly more than what I need) For example the tank gage shows 80 pounds pressure but I can not inflate a tire to more than 70 pounds pressure The kind of air tank that I am referring to is about 4 feet long 1½ feet in diameter mounted on wheels and equipped with an electrically driven air pump Why don t the tank force air into a tire or anything for that matter until the pressure is the same in both tank and tire? I don t see why the tank in the above mentioned case won t inflate the tire to about 75 or 76 pounds, while the tank itself falls from 80 to 75 or 76 pounds. 2 Chemistry texts say that a saturated salt solution freezes at —21 degrees centigrade and therefore a mixture of ice, solid salt and a solution of salt can stay together permanently only at this temperature The result is that more ice will continue melting thus absorbing heat until the temperature is lowered to 21 degrees centigrade below zero I do not see how the salt solution falls below 0 degrees C when everything else around it is 0 degrees C or above. Can you explain? I understand that the solute or substance dissolved uses up some of the heat of the solution in its process of dissociation or ionization. Is that how the salt and water mixture falls below 0 degrees centigrade? 3 In riding along the country roads at night I have often noticed what seems to be a peculiar reflection of light from the trees and telephone poles which are not at all in line with the light rays from the headlights At a distance of 100 feet or so a blotch of light appears on the pole and seems to approach the automobile as the car nears the pole and then dies out. Sometimes I ride for miles without noticing it, and perhaps in the next mile it occurs repeatedly What causes the blotches of light and why don't they appear on all the poles? A 1 There may be several reasons why you can not get the same pressure in your tire as was shown on the tank gage The tank gage may not be as accurate as your tire gage Then the pressure of the valve spring must be overcome if there is one This is to be subtracted from the pressure in the tank to find the pressure in the tire Again the air taken from the tank reduces the pressure in the tank itself unless the pressure in the tank is maintained by constant pumping while the air is being drawn off into the tire If there were no pumping in of air into the tank and the tire took half the air in the tank, the tire pressure would be but half of the tank pressure at the beginning So too of other ratio of tank and tire 2 Heat always disappears in the solution of any solid even when no heat from without is applied to produce solution With a d ll ate thermometer such as a thermopile the drop of temperature by dissolving salt in water carries the temperature of the mixture below the temperature of the place where it is formed It is not at all strange that a solution of salt and ice should cool in dissolving each other The lowest temperature which can be had in this way is 22 degrees C below zero C which is 7 6 below zero Fahrenheit The heat required to dissolve a solid must come from somewhere It will come from the easiest place to obtain it In this case it is taken from the liquid itself if care is used that it shall not be taken from outside bodies We do this in freezing ice cream The heat necessary to dissolve the salt and ice is taken from the cream though in common freezers some heat does get in from outside to delay the freezing 3 The light which you see reflected from the trees must come from some source in your car if there is no other light about It is not probable that there is anything occult about it

(14402) E A C asks In a recent issue of SCIENTIFIC AMERICAN I remember reading that our days were becoming longer at the rate of one (1) second every eight hundred (800) years possibly due to the slight slowing up of the earth s rotation on its axis If I remember this article correctly would it not be possible to figure approximately the beginning of time? A few billion years ago the earth must have rotated on its axis once an hour or once a minute possibly once a second and in a few billion years our day will have approached the length of our month or maybe our year A We note your statement regarding the change in the rotation of the earth and the length of day, and we should challenge the statement that the day is becoming longer by a second in 800 years Todd, in his New Astronomy page 128 says that 'a change of the Earth s rotation as great as a thousandth of a second in a thousand years could not escape detection and no such change has been detected Moulton s textbook of Astronomy the latest we have discusses the matter on pages 77-89 and concludes that the tides could not increase the length of the day more than a second in 500 000 years And later he says that all the causes would have an inappreciable effect in 100 000 years The uniformity of the earth's rotation on its axis which causes the day may be taken as settled for the present epoch If such a slowing up of the earth were taking place we fail to see how this would indicate the beginning of time At the most it would show how long ago the earth would have had a day of any desired length an hour or a minute provided the change had existed at its present value for such a time But if the earth had a planetesimal origin, as many astronomers of repute believe, the rotation must have been very different at different periods of its growth It is not a problem to be settled this year

The First, and Last, 18-Inch Naval Gun

(Continued from page 254)

built up type of ordnance, thus falling into line with American, German and French practice. The 18-inch gun is 40 calibers in length. Its weight unmounted, but including the breech plug, is 152 tons. The armor-piercing projectile weighs 3320 pounds, and with a full charge of 600 pounds of cordite develops a muzzle energy of 150,000 foot tons. It is theoretically capable of perforating 41 inches of hard faced armor at short range, or 20 inches at a range of 10 miles, though it need hardly be said that hard faced armor of this thickness has not been made as yet. The whole of the armor piercing shells for this gun were made by Hadfields. The rate of fire on a naval mounting, as installed in the "Furious," is two rounds per minute. Initial firing tests showed the gun to possess a degree of accuracy, especially at ranges over 15 000 yards, superior to that of all lighter weapons. Given the necessary elevation and proper spotting facilities, it could make accurate practice up to 50,000 yards, and there is no doubting the tremendous destructive effect of a well placed salvo of 3320-pound shells.

As I mentioned in an article on the new British battle cruisers, published in the December SCIENTIFIC AMERICAN, the British Naval Staff would probably have selected 18-inch guns to form the armament of these ships but for the fear that such a step would give an impetus to naval rivalry between the Powers, since neither the United States nor Japan would have remained content with the 16-inch gun when weapons of greater power were afloat in British vessels.

It is just as well that the introduction of 18-inch guns has been indefinitely postponed, for the increased weight of ordnance has been one of the prime factors conducing to the enormous size and cost of modern capital ships. The influence of armament in this connection is revealed by the following figures, showing the weight of a battery of eight big guns twin mounted in turrets on the center line of a ship. Eight 12-inch 50-caliber guns, total weight 3250 tons; eight 15-inch 45-caliber guns, total weight 5300 tons; eight 16-inch 45-caliber guns, total weight 7100 tons; eight 18-inch 45-caliber guns, 8900 tons. Now that the Washington Conference has fixed the maximum displacement of future capital ships at 35 000 tons, it is improbable that any navy will adopt guns of a greater caliber than 16 inches, for if this caliber were exceeded it would be impossible to mount more than six guns in each ship, thus sacrificing the volume of fire which experience in the late war showed to be essential at long range action, when the percentage of hits is bound to be small, however accurate the pointing and spotting may be.

The only 18-inch gun which came into action against the Germans was that mounted in the monitor "Lord Clive." This was in the closing days of the war, when the Germans were evacuating their strongly fortified positions on the Flanders coast, and it was thought that a few rounds of 18-inch shell might hasten the process. An officer who was on board the "Lord Clive" during the bombardment, states that the mounting allowed for a bearing on the starboard side only with a maximum elevation of 45 degrees and a lateral deviation of 5 degrees, giving a nominal range of 45 000 yards with full charges. In actual practice this was probably much exceeded.

Exactitude in Propeller Manufacture

(Continued from page 261)

box. Then the whole assembly is rolled over and the wooden pattern (Fig. 1) is withdrawn. The drag with its sand mold, is then baked.

A similar operation is performed with the cope container (Fig. 1) and the cope or metal flask (Fig. 2).

As every point in cope and drag pattern has been accurately established from surfaces and locating holes, it will be seen that the molding operation has mechanically transferred these pattern forms to a position within the drag and cope molds, this position being accurately established with regard to their respective surfaces and locating holes. After baking the cope and drag are closed and secured together as shown in Fig. 4, and thus the plate form and thickness are established and controlled.

In Fig. 5, three drags are shown assembled on the surface plate, to which they are bolted through holes H. Since every point in the mold impression is established with relation to the surfaces and locating holes, so by the securing of the surfaces of molds to the assembly plate by the locating holes, each point in each mold is established from the assembly plate with identical relation with the corresponding point in each other mold. Thus is established pitch uniformity, blade thickness uniformity, accurate blade location et cetera, when the assembled mold is ready for pouring. The propeller being accurate to design, no corrective machining is required. For wheels built integrally and for commercial use, the equipment is built in three standard sizes, 12 feet, 16 feet and 20 feet in diameter, and each unit is designed for either 3- or 4-blade wheels.

The result of these methods of mechanical precision as described above are shown in the two following tests of propeller wheels.

On a series of five vessels of 8800 tons' deadweight capacity equipped for the United States Shipping Board and having a designed speed of 10½ knots per hour, in trials, speeds as high as 13½ knots per hour were attained. The following comparison of the old and new methods of casting on 3-blade Navy bronze destroyer propellers, 9 feet in diameter and 9 feet 11 inches pitch, are significant.

Advantages of the Thacher Process are as follows: The requirements of design are accurately met and the finished propeller is perfect in diameter, pitch, pitch uniformity, area of blades, blade location, uniformity of metal distribution and balance. As compared to the machine-finished propeller there will be a material saving of approximately 50 per cent, and the production time in the case of large propellers will be reduced two to three weeks for each propeller. The costly machine work formerly required is eliminated, thereby saving not only time and material, but the initial machinery investment, maintenance, tool and depreciation charges. The process permits of standardization of manufacture, which not only means greatly lessened cost and time of production but assures the exact reproduction of a propeller for replacement purposes. It permits of quantity production of a quality and at a cost hitherto considered unattainable and eliminates propeller vibration. The process does not require skilled molders, the molding being purely mechanical. Any intelligent man can be trained in a few days to perform the work. By elimination of machining the casting skin is retained, maintaining the strength of casting as well as its corrosive-resisting qualities, both of which suffer under machine tooling.

The Planets for April

Mercury is a morning star at the beginning of the month, rising at 5 15 A. M. He is drawing nearer the sun and is soon lost to view. On the 24th he passes through inferior conjunction, and becomes technically an evening star, though he will not be visible again until next month.

Venus is an evening star in Aries and is becoming more and more prominent. By the end of the month she sets at 8 30 P. M., and is a very conspicuous object.

Mars is in Ophiuchus—which though not one of the zodiacal constellations is traversed by the ecliptic. He is moving slowly eastward among the stars, approaching the earth and growing brighter, and he surpasses all the stars except Sirius. He rises just before midnight at the beginning of the month, and at 10.25 P. M. at its close. With the telescope he shows a disk of diameter increasing from ten to fourteen seconds during the month, and strongly gibbous, like the moon three days from the full.

Jupiter is in opposition on the 4th, and is splendidly visible all night long. He is in Virgo, north and west of Spica, and cannot be mistaken, as he is brighter than Sirius and far exceeds anything else in sight.

Saturn is also in Virgo, eight or ten degrees west of Jupiter, and, like him, is visible practically all night.

Uranus is a morning star in Aquarius, too near the sun to observe conveniently, while Neptune is in Cancer, and comes to the meridian at 7 30 P. M. in the middle of the month.

The moon is in her first quarter at 1 A. M. on the 5th, full at 4 P. M. on the 11th, in her last quarter at 8 P. M. on the 18th, and new at midnight on the 26th. She is nearest the earth on the 10th, and farthest away on the 22nd. During the month she is in conjunction with Neptune on the 7th, Saturn on the 10th, Jupiter on the 11th, Mars on the 16th, Uranus on the 22nd, Mercury on the 27th, and Venus on the 28th.

SCIENTIFIC AMERICAN

The Monthly Journal of Practical Information

35¢ a Copy MAY 1922 $4.00 a Year

WITH WATERPROOF PAINTS AND CANVAS PAINTING A SUBMARINE SCENE AT FIRST HAND [See page 3 9

A Purely Mutual Organization

New York Life Insurance Co.

(Incorporated under the Laws of New York)

346 BROADWAY, NEW YORK, N. Y.

Seventy-Seventh Annual Statement

DARWIN P KINGSLEY, President

Balance Sheet, January 1, 1922

Securities at Market Value as furnished by Insurance Dept., State of New York

ASSETS	
Real Estate	$8,362,881.00
Mortgage Loans	183,722,805.92
Policy Loans	164,305,141.17
Collateral Loans	2,301,000 00
Liberty Bonds and Victory Notes	120,628,900 00
Government, State, Province, County and Municipal Bonds	155,439,933 50
Railroad Bonds	271,524,487 07
Miscellaneous Bonds and Stocks	7,325,003 00
Cash	11,067,144.16
Uncollected and Deferred Premiums	14,674,443 08
Interest, and Rents due and accrued, etc	13,280,399.90
Total	**$952,632,138.80**

LIABILITIES	
Policy Reserve	$787,157,463.00
Other Policy Liabilities	28,527,025.08
Premiums, Interest and Rentals Prepaid	4,361,995.18
Taxes, Salaries, Rentals, Accounts, etc	7,549,037.63
Additional Reserves	7,485,874.00
Dividends Payable in 1922	42,287,368.71
Reserve for Deferred Dividends	59,303,179.00
Reserves, special or surplus funds not included above	15,960,196.20
Total	**$952,632,138.80**

Paid to and on Account of Policy-holders during 1921	**$124,308,409.00**
Loaned Policy-holders during 1921 under Policy Contracts	**40,871,382.00**
Loaned on Farms during 1921	**15,004,330.00**
Loaned on Mortgages for housing purposes during 1921	**9,646,991.00**
Loaned on Business Property during 1921	**11,358,909.00**

The earning power of Ledger Assets, including Cash in Bank, advanced 0.16% during the year

BOARD OF DIRECTORS

LAWRENCE F ABBOTT
ALFRED L AIKEN
JOHN E ANDRUS
CORNELIUS N BLISS, Jr
NICHOLAS MURRAY BUTLER
GEORGE B CORTELYOU
JOHN H FINLEY
DAVID R FRANCIS
A BARTON HEPBURN
MYRON T HERRICK
GRANGER A HOLLISTER
ALBA B JOHNSON
WILLARD V KING
DARWIN P KINGSLEY
RICHARD I MANNING
JOHN G MILBURN
GERRISH H. MILLIKEN
FRANK PRESBREY
JOHN J PULLEYN
FLEMING H REVELL
GEORGE M REYNOLDS
ELBRIDGE G SNOW
HIRAM R STEELE
OSCAR S. STRAUS
S. DAVIES WARFIELD

THE SCIENTIFIC AMERICAN, May, 1922 Volume 126, Number 5 Published monthly by Scientific American Publishing Company at 233 Broadway New York N Y Subscription price, $4.00 per year Entered as second-class matter June 18 1879 at the post office at New York, N Y under the act of March 3 1879

With the Editors

THIS is our seventh issue in the new monthly form. Indeed, most of us have all but forgotten the old weekly SCIENTIFIC AMERICAN, and the editors for their part retain but a dim recollection of the former routine of getting out a weekly edition instead of the present monthly. With six issues of the monthly behind us, we feel quite familiar with our present task and realize more and more the advantages of a monthly issue. In our present form each successive issue presents still greater opportunities, and we mean to take advantage of them.

IN a journal with as broad an editorial scope as ours, it is imperative that we maintain at all times a strict sense of balance. It is so easy to have our journal become too partial to one field or another, at the expense of all the remaining fields. Especially is this true when there is unusual activity or interest displayed in one particular field, and the natural tendency is to devote page after page to that field to the detriment of the remainder of our editorial content. Radio is a case in point. We all know and appreciate that radio is the subject of the hour Everyone is speaking about radio; radio manufacturers are working night and day to keep up with the demand for apparatus; authors are working at top speed on a dozen or more radio books scheduled to appear within the next few weeks; a half dozen new radio magazines are expected on the newsstands almost any day. We are frank to confess that in the face of all this activity and tremendous interest in the subject, we have been seriously tempted to become editorially unbalanced; that is to say, to devote an undue share of our editorial space to radio. For a while we considered a special radio department, containing the various bits of news about broadcasting stations, new apparatus, etc. Also have we considered running several radio articles in every issue. But after studying the matter most carefully, we believe it to be the part of better judgment to devote only sufficient space in every issue to cover the outstanding developments of the art, leaving the average news items and radio-phone broadcasting announcements and construction data to journals which specialize in this subject. We are going to content ourselves with the big things in radio, in this general magazine of ours; but we are also going to cover the details and specific data in books and pamphlets, in order that each of you as may be specially interested may receive from the SCIENTIFIC AMERICAN the information you require.

SO our first supplementary publication on radio is a book entitled "Radio for Everybody," which is an outcome of the article recently published in our columns under that title, as well as of the numerous inquiries we have received from our readers. This book endeavors to tell about popular, every-day radio in the layman's own language. It is assumed that the reader knows nothing about alternating current and wave forms, variometers and wave [illegible]; yet, starting with the very [illegible] of radio communication, he is taken [illegible] step through the simplest [illegible] to the [illegible] quired space to do so. However, in view of the general scope of our journal and in fairness to all the other fields which we must cover, we again repeat that the outstanding features of radio will be covered in these columns, and specific information on all phases of radio will be handled in supplementary publications. "Radio for Everybody," the first of these supplementary publications, is now ready for distribution as announced this month in our advertising columns.

RECOLLECTION fails to bring to mind any time at which we have had so much really fine material in definite prospect Dr Carrington, for instance, has completed another article on the psychic, in which he deals with raps, knockings, displacements of objects, and other material phenomena of psychic origin, doing for these more or less what Mr Bird does for the mental side of the case in the current issue Two at least, and probably three, articles will follow Mr Claudy's of page 314, in which members of our staff and outside engineers will explain the workings of specific systems of automatic train control Among the very interesting stories on the editorial schedule for early appearance are an account of the ice patrol in the North Atlantic, by means of which, if the warnings are heeded, any repetition of the "Titanic" disaster will be out of the question, and a description of a brand new method for keeping an obstreperous river within its banks, which has been tried out already with success on no less formidable a stream than the Father of Waters. Psychology is being put on a definite commercial basis, so that the individual who wishes an examination of any sort, or the corporation that wishes systematic tests conducted, may call in the psychologist with as much convenience and as much assurance as though the need were for a mining engineer, and we shall tell the story of how this is being done, and how it is being done in a manner certain to react favorably upon our sum of knowledge We shall have an entertaining story of the scientific frauds—alchemy, synthesis of gold, and the like—which at the moment are sweeping over Europe. And we shall have the usual number of good things that come too late to be announced save by their presence in our pages.

SUBATOMIC investigation and theorizing is the order of the day, as those familiar with the work of Langmuir and Aston, to mention but two names, are aware. The ordinary story dealing with these subjects suffers from inadequate illustration The text cannot in the very nature of things stand on its own feet without pictures and pictures, again in the nature of things, must be conventional drawings of some sort devoid of life and lacking in true pictorial interest In the effort to overcome this, the research staff of the Schenectady laboratories has worked up, in animated cartoon fashion, a motion picture showing what really takes place below the threshold of visibility, among the atoms and electrons. We cannot, of course, retain the motion when we exhibit selections from this film in our pages, nor can the makers get away from the necessity of using drawings rather than real pictures. Nevertheless, we are sure that the article based on these movies which will appear in our June issue will give our readers an insight into modern atomic and subatomic hypotheses which they have never before been able to get.

CONTENTS

MAY, 1922

LEADING ARTICLES

SHORTER ARTICLES

DEPARTMENTS

SCIENTIFIC AMERICAN PUBLISHING COMPANY

Munn & Company, 233 Broadway, New York

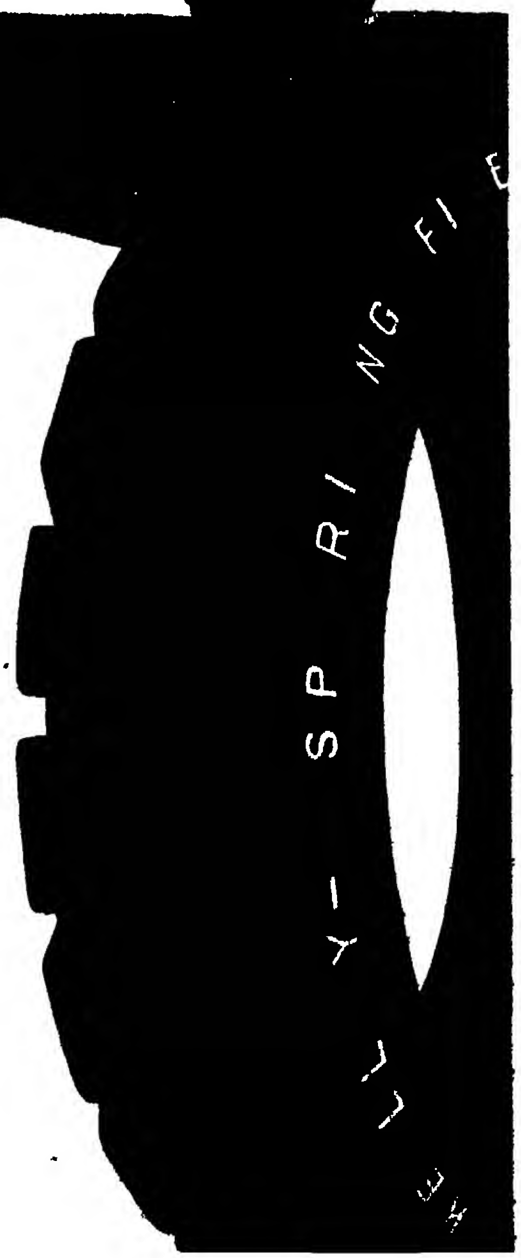
Founded 1845

CHARLES ALLEN MUNN, President ORSON D. MUNN, Treasurer

ALLAN C. HOFFMAN, Secretary

Vol. 126, No. 5. Published monthly Entered as second class matter, June 18, 1879, at the post office at New York, N. Y., under the Act of March 3, 1879.

Price, 35 cents a copy $4.00 a year: Postage prepaid in United States and possessions, and Mexico, Cuba and Panama; $4.50 a year for Canada. Foreign subscriptions, $5.00 a year postage prepaid.



SEVENTY-EIGHTH YEAR

SCIENTIFIC AMERICAN

THE MONTHLY JOURNAL OF PRACTICAL INFORMATION

NEW YORK, MAY, 1922

Where the Money Goes

How Uncle Sam Will Spend His Income for 1922

FOR the fiscal year 1920, as we showed in a chart published in our issue of December 25th of that year, the expenditure by the United States Government in connection with the closing out of past wars was 67.8 per cent of Uncle Sam's annual budget, while the Army and Navy maintenance costs, which are included under the heading of national defense and preparation for possible wars of the future, swallowed up 25 per cent in addition, leaving but 7.2 per cent of the national income available for all the other functions of government.

That the pruning knife placed in the hands of General Dawes and wielded also by Congress itself has not been without effect is seen when we compare the showing of the fiscal year 1922, as forecast in the budget for the year, with the figures quoted above. The wars that we have left behind us cost us now only 53.8 per cent of the year's income; the specter of future wars is to be kept down for the present year's purposes by a salve consisting of only 19.1 per cent of the year's funds, and no less than 27 1 per cent of the nation's income is to be devoted to the regular work of the Government outside the naval and military

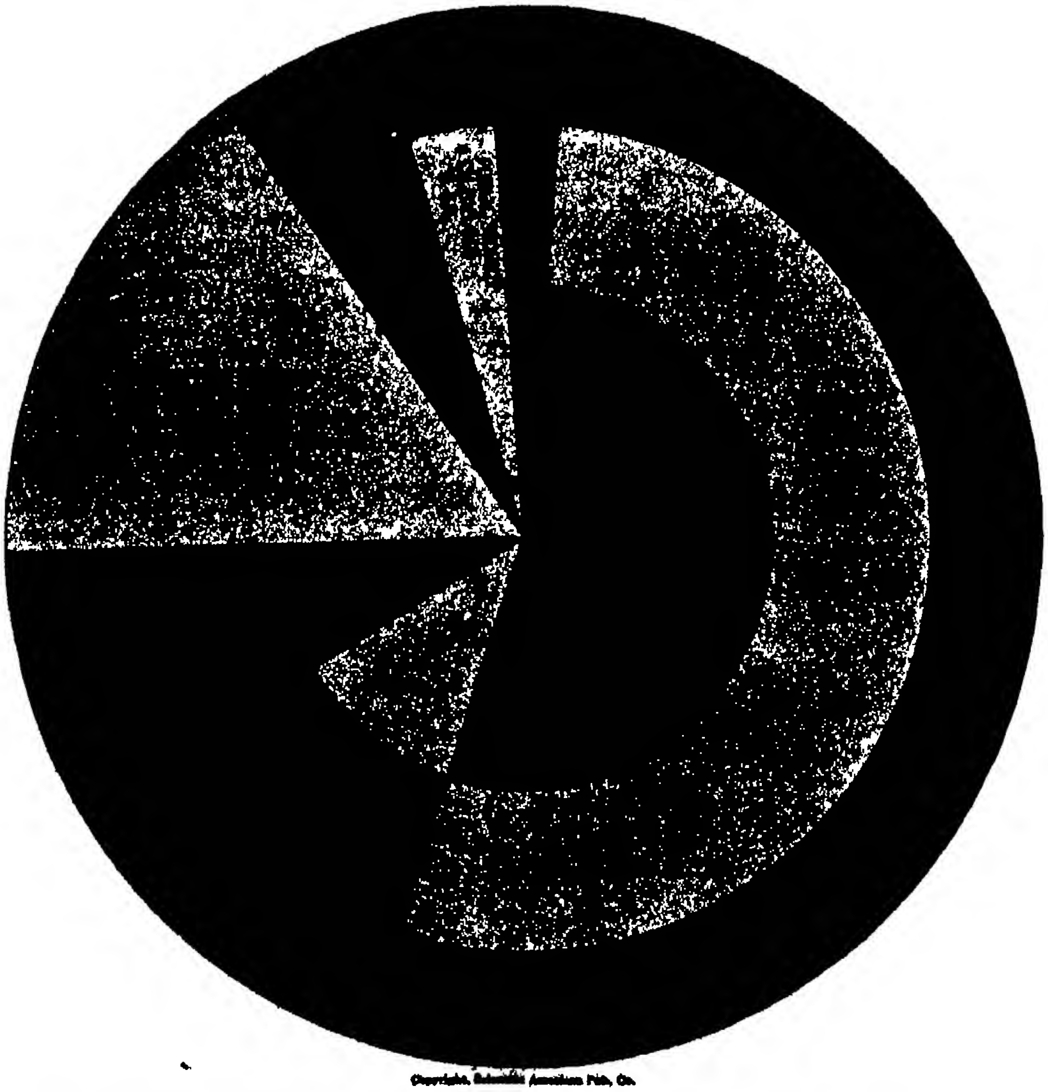
Specific comparison of the items in the present list with those of two years ago shows that a large part of the improvement is due to the elimination of a huge railroad operating loss from the Government's liabilities, and to the fact that Uncle Sam's venture into the shipping field is not carrying nearly so heavy a current expense as it did in 1920. The care of veterans of the World War is costing us more, and pensions paid to veterans of previous wars and their families are about stationary, due to the Congressional habit of raising the rate to keep pace with the diminution in the pension roll due to death.

In the chart herewith we have divided the governmental expenditures into three major groups—the one that has to do with past and present wars and the possibility of wars, the expense of the post office which in theory and to a very large degree in practice as well is met by direct charges against those who avail themselves of the postal facilities, and the other ordinary governmental expenses which represent a charge against the people at large for service rendered them at large. Under the first two heads the chart is sufficiently specific, and leaves no questions unanswered. Under the third, it is otherwise, classification must go much deeper than the chart can take it to give us a clear idea of where this particular portion of the money goes.

During 1922 there will be $105,000,000 of Federal funds spent on good roads—and nobody will begrudge this sum. Aside from the good roads program, the Department of Agriculture will take $46,000,000 out of Uncle Sam's pocket, the entire sum being expended for what we may recognize as research and education and information, plus the necessary administrative expenses over these. The Interior Department will get $34,000,000. Administration of the District of Columbia will cost $24,000,000, the Department of Commerce will get $20,000,000, and in the other branches of the executive, lesser sums will be expended

When we seek to isolate from the rest the specific items which go to research and direct service to the people, we find that the amounts are surprisingly small. The Bureau of Standards must get along on a million and a half, the Bureau of Foreign and Domestic Commerce a little less, the Bureau of Fisheries about the same, the Census Bureau twice as much The Weather Bureau has $1,500,000, the Bureau of Animal Industry, $8,000,000, the Bureau of Plant Industry about two and one-quarter millions, the Forest Service, $7,500,000, the Bureau of Entomology, $1,400,000, the Bureau of Agricultural Economics, $2,500,000. So, while appreciating the improvement over the specific showing of past years, it is still possible to express regret that scientific research and the dissemination of information are allotted such meager sums in comparison with the expenditures for purposes which even their proponents must admit are less useful It is by scientific discoveries that our arts, our industries, our business activities are improved and made more efficient The protection of public health, the eradication of disease, the extension of education, the discovery and development of new industries based upon new scientific facts, are among the assets which accrue to the public from the investigations of scientific men. The achievement of the present Congress in making so striking an improvement over the showing of two years ago is in no way aspersed when we point out the utter inadequacy of the sums that traditionally have been and that still are being spent in governmental support of scientific research We should be able to afford to make this the best financed of Uncle Sam's activities, rather than the worst

It is to be borne in mind that in the nature of the case the figures shown in this chart are but tentative Many of them will be modified by further attention to advance estimates, and in operation during the year economies and unexpected additional expenses will, of course, develop. But the present condition of the budget gives substantially accurate information regarding the relationship between the expenditures of the various classes. The only possibility of serious revision of the ratio between the several classes of expenditure shown by the chart is the very remote one that a bonus plan may be adopted calling for heavy expenditure at once.



The distribution of Uncle Sam's income for 1922, showing the various purposes for which it is used

Taking the Riddles Out of Radio

Solving at the Washington Conference the Perplexities That Complicated Wireless Communication

By George H. Dacy

Copyright, Kadel & Herbert

Assortment of receiving and transmitting instruments employed by a New York radio amateur. Note the elaborate apparatus used. Many amateurs have invested thousands of dollars in their radio stations

BECAUSE the infant radio industry has outgrown its swaddling clothes with a speed as great as that of the mythical beanstalk that Jack grew the most important conference in the history of American radiography—called by Secretary of Commerce Hoover at the behest of President Harding—was convened recently at Washington and has laid the foundation for correcting the defects which jeopardize our most novel method of communication One year ago the problems of the radio telephone and telegraph were relatively few and simple There then were but 50 000 wireless telephone receiving sets in use in this country At present there are more than 600 000 receiving sets in use—some authorities place the total at 1 000 000 or more The comparative cheapness of these equipments and the fact that the American boy takes to them with the same avidity that he accepts long trousers, indicate that in the near future apparatus of this type will be a fixture in practically every progressive American home

The use of the ether—the name given to the medium through which radio waves travel—is not limitless It will accommodate just so many wireless messages and no more When this limit is exceeded chaotic conglomerations of sounds which rival the busy day noises in a boiler factory prohibit the sending or receiving of any kind of messages Because ether chaos threatened our radio industry the conclave of radio experts assembled at Washington Despite that the conference at this writing is still wrestling with the enigmas associated with remedying the errors of our radio operations the consensus of opinion among the experts—these views will probably be the basis for potential legislation by Congress—is that (1) complete authority to control radio in the United States should be vested in the Secretary of Commerce (2) that the radio apparatus used throughout the country should be of the types most effective in reducing interference (that is eliminate the use of inferior and defective sending and receiving sets) (3) that wave lengths be properly allocated to coincide with the present status of the industry

The initial sessions of the Radio Conference consisted of open meetings to which every branch of the radio industry was invited in order to make suggestions to offer criticisms or to point out the advantages of certain systems and methods Thereafter a special committee of which Dr W S Stratton director of the Bureau of Standards is chairman was created The other members are Major-General G O Squier Chief Signal Officer of the U S Army Captain S W Bryant of the U S Navy J C Edgerton superintendent of the radio service of the Post Office Department W A Wheeler U S Department of Agriculture Representative W H White Jr, of Maine R B Howell Omaha Nebraska post office expert who recently has returned from an investigation trip of the European radio industry Dr A N Goldsmith, secretary of the Institute of Radio Engineers, H P Maxim, president of the American Radio Relay League of Hartford, Conn., Professor A. L. Hazeltine, Stevens Institute of Technology, D B Carson, Commissioner of Navigation, Department of Commerce, Professor C M Jansky, University of Minnesota, and E H Armstrong, Columbia University. The members of this committee were appointed to discuss the accumulated data and make definite recommendations The committee has referred its tentative findings to the legal section to draft the new radio law which will be presented to Congress by Representative White A tentative report has been adopted which has been sent to all the original representatives to the conference for review and suggestions After all the points at issue have been thrashed out in this way the conference will reconvene to make whatever advisable changes are necessary

Unquestionably, the new regime which shortly will begin the revolutionizing of America's radio situation, will centralize the control of the industry in the hands of the Government Recently, the Secretary of Commerce has been hindered in his administration of the laws of radio enterprise because they were enacted in 1912 and have never yet been revised to correspond to the remarkable developments which have been made since that period. All agencies represented at the Conference were unqualifiedly in favor of regulations for the radio industry, but they felt that these rules should be made of rubber to the extent that they could be changed and stretched to cover future exigencies which may developed in an art that is so young

Secretary Hoover throughout the conference championed the cause of the American boy He emphasized the need for protecting the interests of the amateurs. He also was desirous that regulations be developed which would permit of Uncle Sam handling the administration of the reinforced radio laws which soon will be passed by Congress for the best interests of the radio industry One of the fundamental achievements of the conference in executive session will be the allocation of wave lengths. Another probably will be the regulation of broadcasting Such suggestions have been made as that the amateur wave length band of 150 to 250 meters should be expanded upward as the amateur's tendency toward interference decreases This would benefit the small boy as his knowledge about his radio set increases. Proposition was also made to confine the broadcasting of concerts, advertising athletic contests sermons, and other addresses to certain other bands while higher wave lengths would be set aside for the official government communications and for ship-to-shore messages. The broadcasting should be classified according to the findings of many radio experts so as to eliminate interference Special hours for broadcasting will also doubtless be scheduled potentially with all business and commercial messages being handled during the daytime, and entertainments, concerts and other musicals holding forth exclusively at night.

In opening the Radio Conference, Secretary Hoover said "This conference is called at the request of the President, and its purpose is to inquire into the critical situation that has arisen through the astonishing development of the wireless telephone. Its purpose is to advise the Department of Commerce as to the application of its present powers of regulation and to develop the situation generally with a view to recommending to Congress, if it be necessary, to extend the present powers of regulation This is one of the few instances that I know of in the country where the public—all of the people interested—are unanimously for the extension of regulatory powers on the part of the Government. In undertaking the organization of the conference, we have considered that it was desirable to draw the Committee that is to give consideration to the results of the conference largely from technical men representing the different government departments and services."

There are more than ten million telephone [illegible] in this country. If they substituted radio [illegible] for the ordinary [illegible] in their daily [illegible] would [illegible] far [illegible]

Copyright, Keystone View Co.

Typical radiophone transmitter, such as is used in various parts of the country for broadcasting purposes. It is the relatively low cost of such equipment that has caused so many small broadcasting stations to spring up and cause undue interference.

situation was discussed. Under proper regulation, the wireless telephone has a distinct field. It is adapted to the distribution of certain pre-determined material of public interest from central stations. This material must be limited to news, educational affairs, entertainment and communications about such commercial matters as are of importance to large groups in the community Wireless should not be used for communication purposes which could be served satisfactorily by other agencies such as the telephone or telegraph The only radio laws which have been administered consist of the issuance of radio licenses by Secretary of Commerce to radio sending stations subject to certain conditions designed to prevent interference between the stations and to serve the public good.

Up until the last six months, little difficulty was evident in the transmission and reception of radio messages. The sending previously had been confined largely to the radio telegraph. The recent extensive use of radio telephone has completely changed conditions and has necessitated the regulation of the use of the ether Most licenses have been issued to government broadcasting agencies and to American amateurs. Rules are needed to prevent interference between the sending stations by the proper arrangement of wave lengths. It is possible to increase the number of sending stations and thus the volume of material distributed if the power applied to certain wave lengths is limited so as to circumscribe the area of distribution from a given station Certain times of day may be set aside within certain wave lengths for the sending of certain types of information Thus, a receiving set owner might tune his instrument to different wave lengths to receive a wide range of information Universities, technical schools and governmental offices all are willing to distribute valuable information Merchants are anxious to install sending sets and to disseminate such data if they also are permitted to use the outfits for advertising purposes Newspapers desire sending sets and licenses to broadcast news and entertainment and to undertake commercial broadcasting of one kind or another

Representatives of one of the leading communication systems reported to the conference that their organization operated the only commercial radio telephone line in the country today It connects Catalina Island and the California mainland This system known as the radio link, was described in our November, 1921, issue Practically none of the subscribers to this service know that it is wireless as they get their numbers from a telephone book and call the central operator for connections This operator switches them from regular telephone service to radio telephone when they ask for Catalina Just to show the wide distance over which radio telephone messages may be transmitted even when they are of short wave length, it is worthy of note that the British Navy reports that one of its ships picked up a message off the coast of Australia which had been sent from Los Angeles and destined for Catalina

There is one county in the United States located in the Kentucky mountains which has neither telegraph nor telephone facilities while it also lacks both post road and railroad. It would cost over $100,000 to equip this section with a telephone line about 40 miles long A public radio telephone service could be established at a much lower cost. In sections where topographical features or other disadvantages prohibit the use of the regular telephone, the wireless telephone offers commercial possibilities For the use of the U S Forest Service it is of value in forests where wire lines cannot be installed or where the fire hazards which might cause the downfall of a pole line are excessive

Representative White of Maine is a staunch advocate of radio regulation He maintains that the type of material broadcasted should be regulated Crop reports and weather predictions are much more valuable than theater advertisements He also contends that certain wave lengths should be allotted to telegraph and telephone companies for emergency uses. The commercialization of public radio service will soon be tried out experimentally in New York City where the first public broadcasting station will be operated. It is a step toward the standardization of radio broadcasting and may result in the reduction of the indiscriminate use of the ether which recently has been objectionable

The development of the public radio telephone pay stations means that certain wave lengths will have to be granted to the public corporations to render this scheme successful The communication system that has fostered the initial public pay station reports that it was besieged by private firms that desired to purchase radio sending sets so that they could use the ether commercially The communication system decided that the best way to solve this demand was to establish public pay stations Early experiments indicate that messages of short wave length which were hard to pick up by faulty receiving sets 20 miles from New York traveled as far as 1000 miles from land off the Pacific Coast where they were picked up by oil tankers

Representative White contends that the allocation of certain wave lengths to reputable communications companies which will operate them for commercial purposes under strict regulation by Uncle Sam is one of the sensible ways to solve the ether enigmas which have complicated radiography He purposes to introduce a radio control bill into Congress based on the findings of the radio conference He advocates the delegation of authority to the Department of Commerce to exercise complete control of the radio telephony in this country and the right to classify stations as transcontinental transoceanic ship-to-shore amateur and the like Certain wave lengths should be assigned to each station Portions of the day should be reserved for the transmission of certain kinds of information Limitations should be put on the use of certain wave lengths Control should be lodged in a civil rather than a military branch of the Government because this communication medium is the right bower of domestic and international commerce

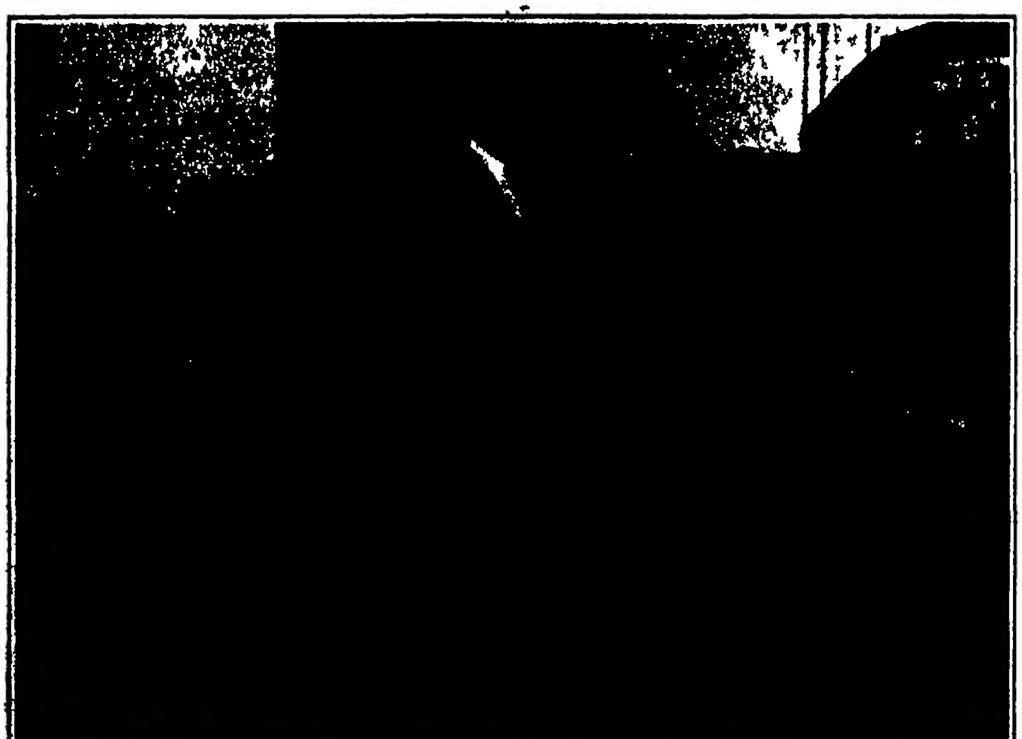
Interesting statistics were presented to the conference by representatives of one of the leading makers of radio sets and equipment According to these figures it would cost commercial concerns approximately $15 000 to install and $25 000 a year to operate a broadcasting equipment not figuring on the easements or rentals the cost of musical instruments and the services of artists It would cost between $750 000 and $1 000 000 to put 10 broadcasting stations in operation in different sections of the country This same expert said that his company could market 60 000 vacuum or electron tubes a month—the demand is so great—if they made that many He announced that his concern was selling radio sets at the rate of $50 000 000 worth a year One morning recently this firm received 600 telegrams ordering radio sets in the course of the forenoon

The radio telephone is a particular boom to the American farmer It supplies him with daily market reports and weather forecasts in addition to providing him with entertainment in the form of music lectures or sermons after the day's work is completed Farm Radio Clubs" made up of rural boys and girls interested in the radio telephone are being organized in all sections of the country by the Department of Agriculture There are more than 32 000 000 farmers and their families in the United States that are relatively isolated from the leading news centers. The radio telephone eliminates this isolation Through the Post Office Department Uncle Sam daily sends out reports on the live stock, grain vegetable fruit hay and cotton markets so that any farmer in the country equipped with a receiving set may get this information. State farm bureaus and agricultural col-

(Continued on page 364)

Copyright, Keystone View Co.

Virtually any sound can be transmitted by the radiophone In this instance the radiophone broadcasting station is transmitting music obtained by rubbing drinking glasses



Copyright, Keystone View Co.

A radiophone broadcasting station sending out the voice of a child singer, accompanied by a piano and banjo. Note how the microphones provided with horns, have to be placed in order to catch the desired sound waves

Our Wasteful Industries

Six Major Manufacturing Groups That Make a Bad Showing as Regards Operating Efficiency

By Robert G. Skerrett

TAXATION experience of the past decade ought to make it clear, even to him who dodges unwelcome conclusions, that it is the ultimate consumer who pays the bills, whatever their nature. No producer can go on producing at a loss, whatever he spends, either in actual production or as an incidental thereto, he must get back from his customers, and they from theirs, and so on, down the line, until we come to the man who buys, not for resale, but for his own use. Like the rabbit in the Congress of Animals he has no one beneath him to whom he may pass it." And so it is that industrial waste is of interest to all of us; for in direct measure with its prevalence we all pay more for what we eat and wear and use. Mr. Skerrett tells here the story of recent investigations, which indicate that the sum total of preventable waste in our industries is much larger than we should have imagined. —THE EDITOR

AMERICA is coming to a realization of the measure of her industrial waste. At least this is true of a leavening group of our technicists and some of the executives responsible for the management of a goodly number of our big enterprises. On the other hand it is doubtful if more than a modest part of the public is conscious of the conditions in productive effort which are imposing a heavy burden annually upon the people at large. This negligence or indifference entails ineffectual outlays each twelvemonth totalling billions of dollars.

This arraignment of our methods or lack of them, as the case may be, would be disheartening if remedies were not at hand. It is practicable for us to apply these corrective agencies and thus to achieve tremendous economies and to bring down prices proportionately. Not only that, but certain of these changes in practice or procedure would hasten the day of keener cooperation and more sympathetic understanding between the worker and the man who employs him.

Much of the material contained in this article is drawn from the report of the Committee on Elimination of Waste in Industry. This body was organized by the Federated American Engineering Societies in January of 1921 and was inspired by Mr. Herbert Hoover. During a period of five months the committee made an intensive study of waste in six of our important industries: men's clothing, boots and shoes, textiles, printing, building and the metal trades. The purpose of the committee is to make similar assays of other branches of our industrial life. In the meantime their revelations furnish ample food for thought inasmuch as some of the defects or shortcomings discovered are general and in no sense peculiar to any of the businesses studied.

All of us must have a roof for shelter, and the price of ownership or the amount of the rental depends upon the cost of construction and upkeep. Further, the ultimate consumer has to pay for the buildings that house industries or any other activities that contribute in one way or another to his needs, his comforts, his conveniences or his pleasures. The building industry two years ago required 3 000 000 mechanics and laborers—about 7 per cent of the nation's total of persons engaged in gainful occupations. The labor of these men increases the country's wealth annually by more than $3 000 000 and yet the material returns fall far short of what they could and should be.

There are three primary causes of waste in building operations: irregular employment of the workmen, inefficient management by those in charge and the hampering regulations imposed by labor organizations. Then there are secondary wastes which are attributable to customs or conditions prevalent in the industry, and to these may be added the use of poorly designed equipment which not infrequently retards construction and invites the sacrifice of materials. Finally there is the price paid for accidents which are mainly preventable.

In their analyses of the several industries investigated the committee assumed a theoretical aggregate of 100 points as representative of the maximum possible waste, and the observed waste was then apportioned to the accountability of the management, the worker and the outside contacts. In the case of the building industry, taking it by and large, the experts registered 53 points against it, and responsibility was ascribed as follows: management, 34.3 points, labor, 11.3 points and outside contacts, i.e., the public, trade relationships, etc., 7.4 points.

The deficiencies of management are greater than most of us would imagine, and by reason of them there is wastage of time, material and labor in many directions. All too often there is a lack of forethought in planning for the execution of a job, little attention is devoted to progress schedules which insure a proper flow of materials so that there will always be enough on hand to meet requirements; the cost keeping methods relied upon by most contractors are inadequate, and the average builder gives only superficial heed to the amount, type and location of equipment which may play a prime part in cheapening and in speeding up performances.

Again, contractors in this field rarely have an employment service that deserves the name, and it is only occasionally that the men in this business have preference lists based upon an intimate knowledge of the capability of the individual worker. These shortcomings sooner or later add heavily to the bill, while efficient management can raise the earnings of all concerned and lessen the while the expenses incident to a properly executed undertaking.

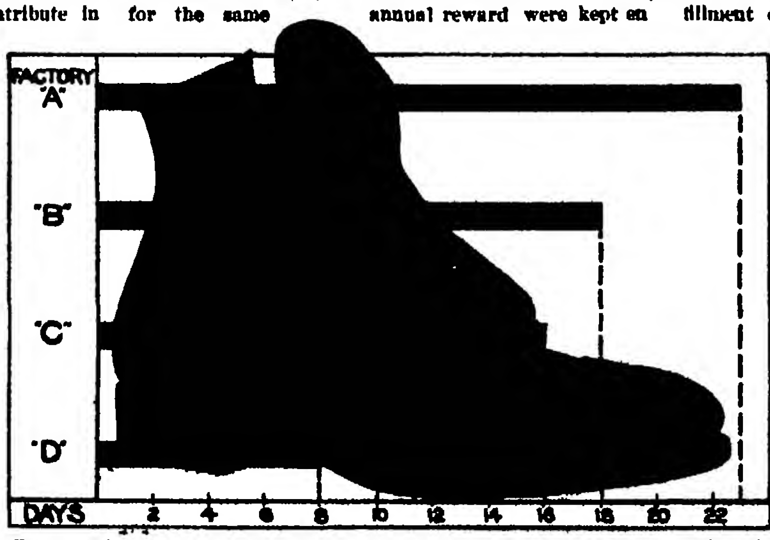
As matters stand today workmen in the building industry are busy as a rule only two-thirds of their time in the course of a year, and their expectation is a wage for that period sufficient to maintain them the entire twelvemonth. In other words, the owners of buildings are compelled to pay 33 1-3 per cent more for the item of labor than would be needful if the men, for the same annual reward, were kept engaged the year through. Progressive contractors are finding ways to reduce seasonal unemployment either by protecting the men on the job in cold and inclement weather or by so arranging their activities that there will be something to do all the while. The gains in accomplishment and the potential savings by the common adoption of this procedure cannot be stated in exact figures, but from the evidence at hand it is plain that the benefits would be momentous. It is authoritatively estimated that construction labor costs can be cut 3 per cent by the institution of appropriate safety measures, and that from 75 to 80 per cent of the loss and waste due to accidents can be prevented.

And now we come to the sources of some of our wearing apparel. The manufacture of men's clothing calls for the services of 1 000 000 persons, and two years ago the 5254 establishments in the business had an output valued at $1,158 006 904. Owing to the seasonal nature of the demand for garments, the investigators discovered that the average plant utilization over a three-year interval of eight big representative factories did not exceed 69 per cent of a possible maximum. During a twelvemonth this intermittent productiveness on the part of the operative is equivalent to nine hours of idleness in every working week. We are told that at least ten hours more count for naught by reason of energy wasting and time-wasting shop methods, while another two or three hours are lost weekly through unnecessary labor.

In the slack periods a goodly number of the large concerns run at only 30 per cent of their capacity, while many of the small ones are closed. It is probably conservative to say that the great bulk of the shops could get along with 50 per cent of their existing plant capacities if they were operated at a uniform rate from one end of the year to the other. This would also obviate laying off the hands for 31 per cent of the time annually, would make for content and stabilise labor conditions and would lower the cost of the garments turned out.

The usual practice in the trade is to make goods only after the receipt of orders—in other words, to respond to a 'bunching' of demands at certain seasons, and heretofore the manufacturer has been required to make up many different models in various sizes in lots of from two to twenty. Not only that, but to attract trade the producer has allowed his customer to choose materials from numerous patterns. Even so an order is at present not necessarily a sale. All too often purchasers who buy on long time credit either cancel the order while in the process of fulfillment or they return unsold garments when they are no longer marketable and expect credit therefor. The maker must look for a buyer elsewhere and he saves himself from loss on this deal by adding proportionately to the price of other lots of goods. The citizen who wears ready made clothes pays for the wastefulness and the lax methods of the industry.

The engineering experts are convinced that the whole business can be materially bettered by limiting the number of models and the styles of cloth, by manufacturing for stock so as to bridge over dull seasons and by standardizing machinery and having in reserve sufficient apparatus to maintain all operating equipment at a maximum stage of efficiency. The investigators are of the opinion that the men's ready-made clothing industry can readily be brought to a state where it will be feasible to effect an aggregate daily saving of more than $750 000! According to the survey, the industry is charged with 63 78 points of waste, which are apportioned as follows: management, 49.33; labor, 16.5, and outside contacts, 4.95. Of the six businesses reported upon, this one was found to be the least efficient.



Four factories, engaged in making the same grade of shoe, showed a discrepancy of nearly 300 per cent in the amount of labor going into a pair of shoes. Factory D enjoyed no inherent advantages over the others and may be taken as a normal standard of what effective management can accomplish throughout this industry

What industrial waste means when we bring it right down to a representation in terms of the finished product

The boot and shoe industry represents a capital investment of $500 000,000. It is made up of 1300 companies; employs 295,000 persons; and turned out last year commodities to the value of $1,300,000 000. In the course of the twelvemonth, the factories fabricated 300,000,000 pairs of boots and shoes, and the earnings totaled $260,000,000—a profit on an average of 90 cents per pair.

Like that branch of the ready-made clothing industry just considered, the boot and shoe industry is subjected to intense seasonal demands, with intervening periods of greatly reduced activity. The shoe plants of the country have a capacity of about 1,750,000 pairs a day, and yet the average output is only 977,000 pairs on the basis of a 300-day working year. As a matter

of that, however, the operatives do not work 300 days a year. The manufacturers estimate that the average shoemaker is engaged at most 65 per cent of his possible productive hours, and this means 35 per cent or more of idleness annually The wage paid is therefore set high in order to neutralize the weeks when nothing is earned.

The problems of the industry are increased by the vagaries of style. As it has been expressed "Millinery in footwear is outstripping millinery in hats", and sales records show that for every pair of shoes bought by a man a woman will get four pairs. It is not hard to grasp that multiplicity of sizes and varieties of kinds add heavily to the aggregate cost of output and to wastage Substantial economies could be effected by putting out fewer novel styles, and by distributing the making of staple patterns throughout the year Scientific management has a chance to do much in the boot and shoe industry It is computed that the fluctuation of seasonal demands, and the losses of time due to unbalanced production of associate departments cause the item of labor on a pair of shoes to be nearly double the possible minimum. In other words, wasted time now occasions annually a sacrifice of $65,000,000 How much room there is for improvement in the boot and shoe industry can be gathered from the fact that the investigators charged it with 40.93 points of wastage, management, 30.25, labor, 4.85, and outside contacts, 5.83.

The textile industry in the United States is said to rank second only to the iron and steel industry in the amount of money involved, and the invested capital is conservatively put at $8,500,000,000 In 1920 the value of its products was about $7,000,000,000, and all but $500,000,000 worth of the commodities were used at home. The industry comprises the manufacture of fabrics for wearing apparel, of carpets, of draperies, of blankets, of sheetings, and of numerous other woven, knitted, and felted materials. There are 12,004 plants in the business. The general status of the industry, gaged by a possible maximum of efficiency, falls much below the attainable standard, and the average of waste is put at 49.2 points, the responsibility for which is as follows. management, 24.7, labor, 4.7, and outside contacts, 19.8. On the face of it, the industry has still to cut down its wastage by nearly 50 per cent. Supposing that 20 per cent of the manufacturing cost be due to preventable waste, then the ultimate consumers are paying every year $1,400,000,000 more for these goods than they should.

The metal trades industry, as a whole, is the largest of our manufacturing activities in the value of its output. The working army totals 2,060,000, and it is entirely practicable through increased production to swell the returns annually by over half a billion dollars. At the present time, due mainly to extensive unemployment of available men and machinery, the waste is close to $1,000,000,000 in the same interval.

The metal-making branch of the business has not been included in the survey. This has been confined to those divisions which fabricate raw materials, so to speak, and have to do with machinery and machine tools; automobiles, trucks, and tractors; engines, locomotives, cars and trucks; machine shop and foundry products of many sorts; shipbuilding and ship repairs; electrical commodities of divers kinds, and firearms and ammunition. The experts declare that the average metal-working establishment is 25 to 30 per cent behind the best plant in output per employee What can be accomplished in the way of eliminating waste by improved management is typified by a factory where 1175 operatives turned out 22,000 units in a week and where, a year later, performance was raised to 84,000 units per week by a force of only 800!

The metal trades have scored against them an aggregate of 28.66 points of waste—i e, management, 23.23, labor, 2.55, and outside contacts, 2.88. In brief, management is accountable for 81 per cent of the losses attributable to non-production.

Printing in one form or another touches us at wellnigh every turn, and few of us are conscious of what we pay for this appeal to the imagination and reasoning faculties. The printing industry involves a total investment of substantially $1,500,000,000, and the output in 1919 was valued at more than $3,000,000,000. The business embraces among other activities the manufacture of printing machinery, printing ink, paper for printing, and type founding. The scope of the investigation, however, was limited to book, job, and periodical printing The United Typothetae of America estimates that the printing industry is overequipped anywhere from 50 to 150 per cent, which means that there are hundreds of millions of dollars tied up in idle apparatus, etc And it seems that there is a fluctuation of 50 per cent in the number of employees engaged at different seasons of the year in the more pretentious printing and binding establishments.

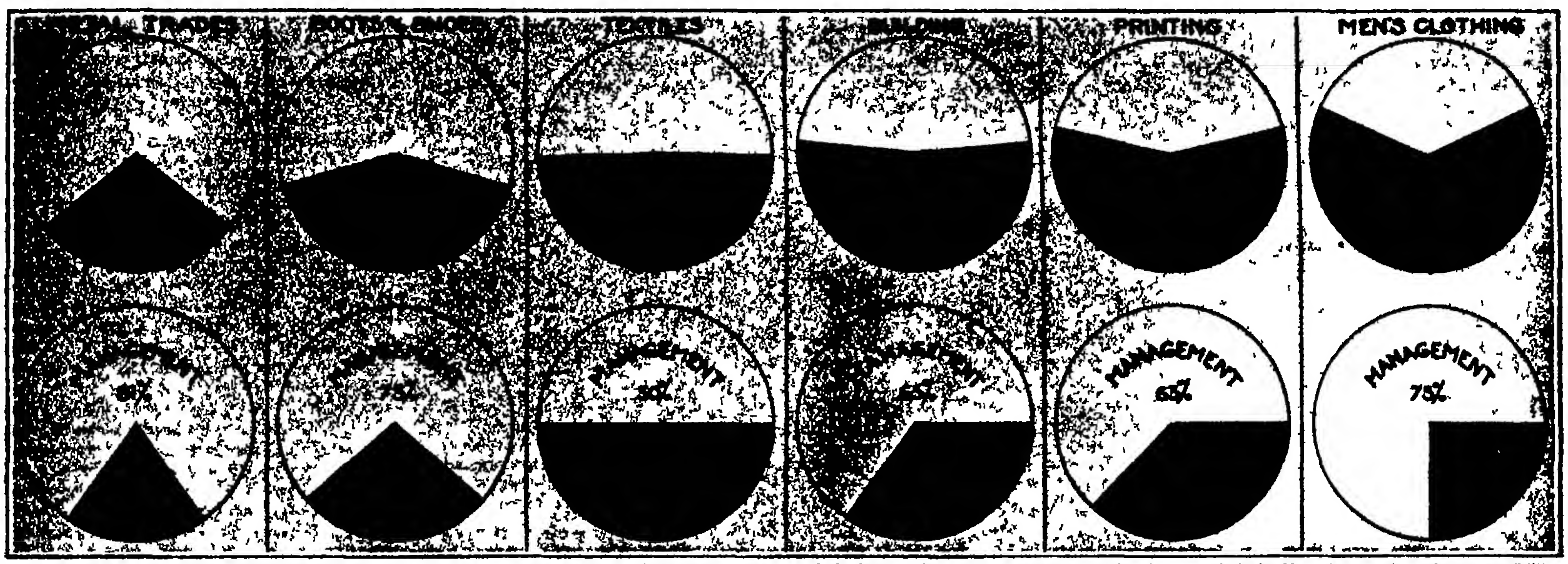
The survey rates this business as wasteful to the measure of 57 61 points and divides the inefficiency in this manner management, 36.36, labor, 16.25, and outside contacts, 5. Faulty management must answer for 63 per cent of the factors that make for waste, and in this industry, as in the cases of the five others analyzed, a lack of proper administration is the predominant weakness. The standardization of machinery, of paper, of inks, of colors, and of columns, pages, and sheets would effect enormous economies. It has been stated that the standardization of newspapers to one size would make possible an annual saving of from three to five million dollars in the charges for composition and plates alone. Taking into account the diversity of dimensions among current magazines, trade publications, etc., we are told that these variations, "which accomplish absolutely nothing," either directly or indirectly, tax the public's purse to the extent of not less than $100,000,000 each year. Out of a total of 1588 plants only 56 had a cost system, and 1295 of them lost money in 1919.

In conclusion, let us dwell briefly upon the losses incident to industrial accidents and to the impaired health or physical deficiencies of the workers. According to the latest figures available, those for 1919, there were, during that twelvemonth, 23,000 total fatal accidents; about 575,000 non-fatal accidents causing disability for four or more weeks, and something like 3,000,000 accidents which laid the employees off for at least a day. To quote the report of the Committee on Elimination of Waste in Industry. "If we may assume an average wage of $4 per calendar day ($28 per week) the above time lost represents a wage loss of $1,184,000,000 From this we may subtract the actual cost of subsistence of the men killed, which may be placed at approximately 60 per cent of their wages, or about $331,000,000. This leaves a net economic loss to the country of about $853,000,000 for the year 1919." There might seem to be an inaccuracy here, since 60 per cent of 1184 is not 331 The former figure refers to men both killed and injured, however, while the latter includes the living cost only of those actually killed. Eminent authorities are agreed that it is entirely practicable, by adopting methods already tried out, to reduce deaths and serious accidents—and therefore to lessen accident cost—in American industry by at least 75 per cent

The general death rate among industrial workers, ranging in ages from 15 to 65, was estimated in 1920 to be 11 46 per 1000 living With a population of 42,000,000 gainfully employed this would be equivalent to a vital sacrifice of 481,300 By systematic medical inspection it would undoubtedly be possible to greatly diminish this mortality Eye conservation, through preventive or protective agencies, has made long strides forward and in many establishments these precautions have cut down eye accidents anywhere from 50 to 85 per cent

One of the most suggestive aspects of this subject is the steps that have been taken by some concerns to correct substandardized vision By the fitting of proper glasses, the operatives in one plant, where fine work was done, improved their productivity fully 28 per cent in the course of a couple of months. A firm engaged in the manufacture of paper boxes had the eyes of its 3000 hands examined, with the following results 22 per cent were found to be normal, 38 per cent were astigmatic, 28 per cent were hyperopic, 7 per cent were myopic and 5 per cent were color blind. This gives some idea of the prevalence of substandard vision—a deficiency which may bear directly upon the quality of workmanship, the waste of materials, and even the well-being or safety of the personnel Again, vision is often hampered by the conditions of lighting, and improved illumination soon pays for itself and makes for a better and fuller output

No small part of industrial waste is the consequence of labor's lack of interest in repetitive or monotonous tasks, which are important because of the quantities involved or for various other reasons. There is a growing tendency to introduce factors of a competitive nature which will lend color to comparative drudgery and thus stimulate initiative resourcefulness, and even the creative faculties One way of achieving this is to chart progress in eliminating waste of material—success in this being proof of a gain in knowledge and skill The response, where this has been tried, has been extremely encouraging A single instance will serve to illustrate the benefits in a pulp mill, the yearly production was raised from 42,000 tons to 111,000 tons without adding to the number of digesters for cooking the pulp, or without amplifying the wet machines for handling the finished product and the ultimate commodity was changed from one of poor quality to the very best grade



In each instance the upper figure indicates the total measure of waste in the industry in question; and the lower takes the total waste, considered as a unit in itself, and apportions the responsibility for it among the workers, the managers, and the customers, legislators, and other outsiders

A graphic arraignment of wastefulness in six of America's greatest industries

Cutting and Fitting Beneath the Waves

The Under-Water Torch Speeds Up a Difficult Repair Job on the Narrows Siphon

By Ralph Howard

FULLY 125,000 people of the Borough of Richmond of the City of New York are commonly dependent for their daily supply of water upon a large cast iron conduit 10,000 feet long which is laid in the bed of The Narrows, a navigable route between Staten Island and the Borough of Brooklyn. This main is joined with the Catskill water supply system on the Brooklyn side of the harbor and discharges ultimately into Silver Lake reservoir of the Borough of Richmond.

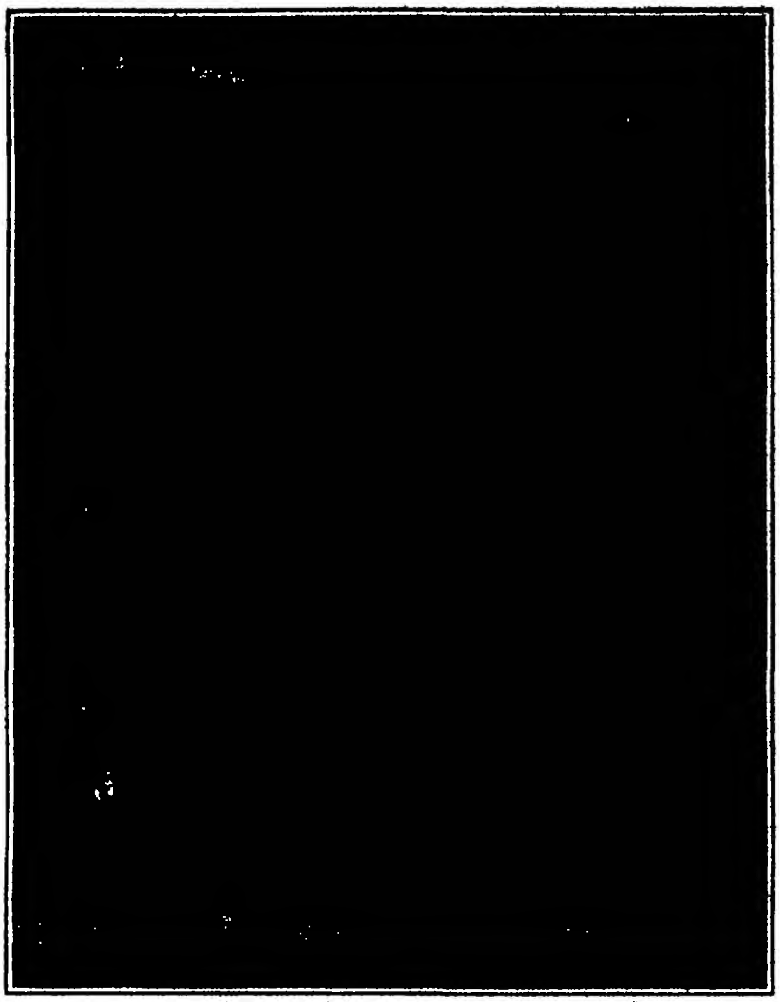
While engaged in deepening the slip adjacent to the northernmost of the new municipal piers, lately finished along the Staten Island waterfront, a dredge inadvertently dropped one of its big spuds on to the conduit close to the inner bulkhead line and smashed a large piece out of one of the pipe sections. At that point the top of the main lies 50 feet below the harbor's surface and under an overburden of 28 feet of mud—much of which is of the consistency of silt. The damage necessitated the speedy closure of the gate valves at the Brooklyn and the Staten Island terminals of the siphon to prevent wasting water especially on the Staten Island side where the only reserve was that in the local reservoir. The situation called for prompt and permanent repairs.

The conduit was constructed six years ago and by a method then novel. Each 12 foot length of the 36-inch pipe carries at one end a bell shaped flare into which the spigot end of the next length is fitted. This joint is sealed by means of an ingenious packing of lead and so designed that a five-degree flexure is possible without impairing the watertightness of the union. The object of this was to permit the main to be assembled progressively on a floating base and then to be launched and laid in a deep trench in the harbor bed by means of a long curved skidway.

The task that confronted the engineers engaged on the repair job was to remove the injured section with a minimum of disturbance of the units contiguous to it to interpose a new length and to bind this link with the flanking ones by joints quite as tight as those previously made above water. Haste was a factor. The undertaking was brought within the realm of the possible by the development in the last four years of an efficient submarine metal-cutting torch now patented.

To appreciate the part played by the torch let us understand the nature of the break, the associate conditions and the work that had to be done to effect the withdrawal of the ruptured pipe. While the fracture was wide and long it was not big enough to permit a diver to get inside of the conduit to bring the torch into action at a point which could not be reached in a satisfactory manner from without. Therefore the first step after alining and blocking up the contiguous sections which had been depressed by the shattering blow was to enlarge the breach. To achieve this the torch had to burn or cut its way through the 1⅝ inch shell of the parallel body of the pipe.

The overlapping bell of a joining length was next severed from its own parallel body by cutting the lower third of its circumference from inside the pipe and the remaining two thirds from the exterior. This vertical cut was on a slant which was so directed as to facilitate lifting that end of the detached section. In order to break the solidly-packed joint between the bell of the injured unit and the inserted spigot of the pipe-length ahead a way had to be devised to accomplish this with a minimum of wracking force. It was therefore decided to cut away with torches a goodly sector of the bell top for the purpose of permitting an elbow like movement when raising the opposite end. When the lifting was begun however the bell detached itself at once without shock. But before the heaviest part of the bell could be cut through the divers had to remove a portion of an enveloping wrought iron band 4 inches wide and 1½ inches thick. This called for two cuts and the work was done in a single day by one diver. The cast iron bell mouth was 3¼ inches thick through, and proved very difficult cutting. The 1⅝-inch walls were cut at the rate of from 4 to 6 inches an hour, depending upon the ease with which the points of attack could be reached.



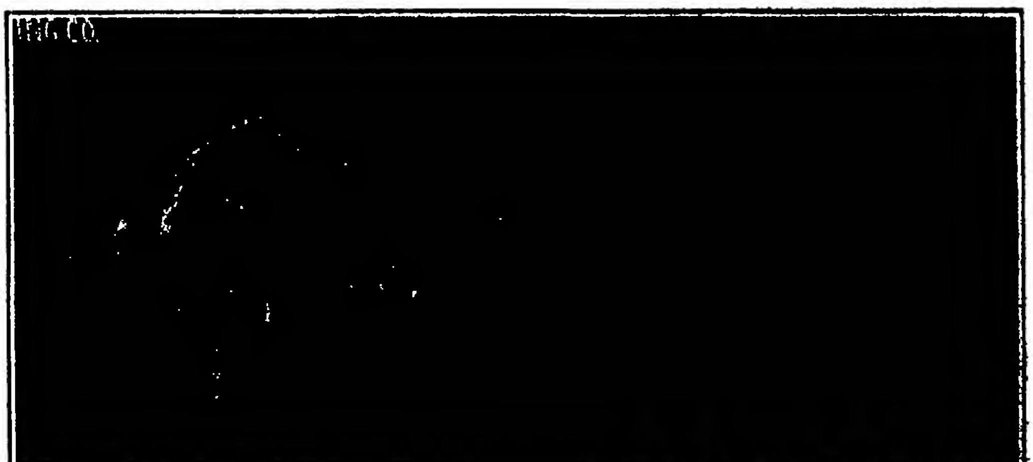
Diagrammatic story of the way the Narrows siphon was damaged and repaired. The dotted lines in drawing 1 indicate the sections cut by the submarine torch in order to facilitate the removal of the injured piping

It should be understood that in advance of using the torch at all the ruptured pipe had to be uncovered so far as the overlying mud was concerned. This was effected by dredging and by powerful suction pumps. In this manner an excavation was made with long sloping sides to prevent the mud from sliding back and in upon the divers. And now for a description of the replacement procedure.

The bell of the new pipe section was slipped over the spigot previously enveloped by the flared end of the injured unit, and this joint was sealed by a packing of lead wool, driven snugly into place under water. This left a gap of about 10 inches between the spigot of the new length and the neighboring section from which the bell had been cut. This gap was bridged by a sleeve 5 feet long, 1⅝ inches thick, and with an internal diameter slightly greater than that of the pipes it embraced. This sleeve was carried down on the new unit, and was then shoved lengthwise so as to envelope both of the pipe ends. The job was completed by packing the two joints with lead wool forced home by pneumatic tools, and, as an added precaution against leakage, flanking rings were secured by screw bolts to check any lateral movement of the metal packing as well as the sleeve itself.

The type of torch which helped so much in the execution of the foregoing undertaking is an evolution of a torch conceived by two experts of the wrecking firm almost four years ago. In its pristine form it was essentially a combined electric arc and oxy acetylene cutting tool which could be ignited under water. This apparatus was used experimentally during righting and refloating of the steamship "St. Paul," which sank at her slip in New York Harbor early in the spring of 1918. But the torch was found to be unreliable and had to be improved before it would cut at depths up to 50 feet. So altered, passages 14 inches in diameter were made with it through the steel plating of that liner. The average time for cutting one of these holes was several hours.

During the righting of the "St Paul" wire hawsers were led from fully a score of submerged concrete anchoring blocks to A-frames on the up-turned side of the steamer and thence back across the slip to a corresponding number of windlasses. After the ship was restored to the vertical the question was how to get rid both of the 1½-inch hawsers and the blocks. The first plan was to remove the wire ropes and the concrete anchors to which they were attached, but it was finally decided that it would be more expedient and equally satisfactory to cut off the hawsers at points level with the surrounding bottom and to leave the blocks in the trench that had been dug for them. The under-water torch was employed for the job; and the 42 steel lines were thus cut off by one diver in the course of three days.



Divers posing, above the water, to show how they worked beneath the surface while cutting the injured cast-iron pipe with the torch

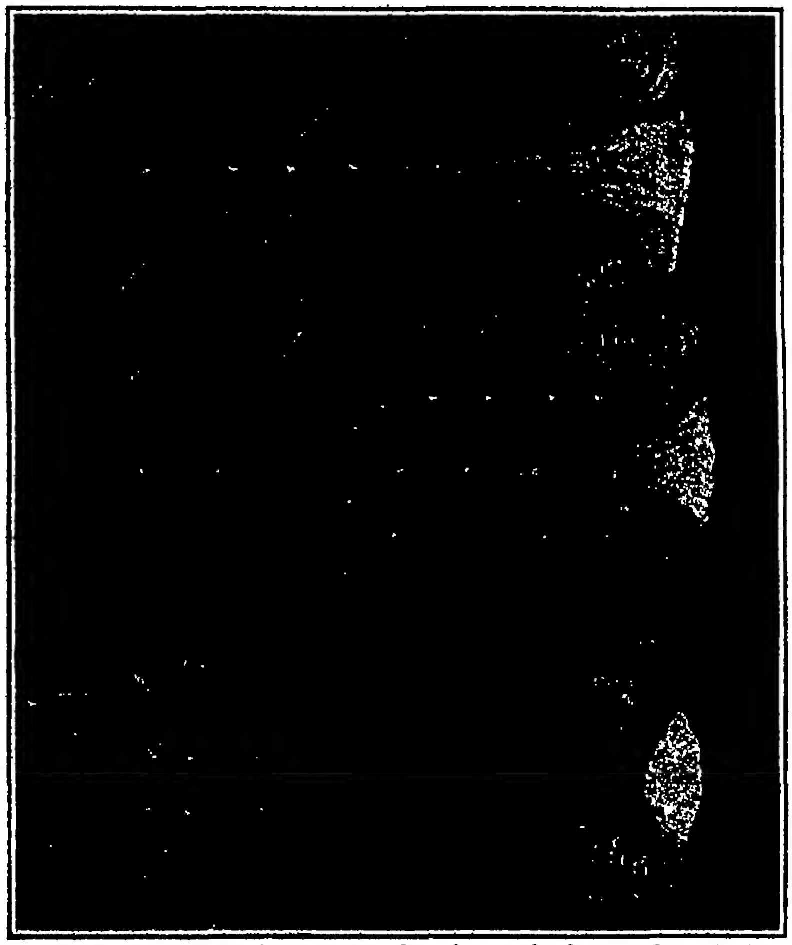
Subsequently, this torch was radically modified and the electrical feature given a good deal more prominence. Last December, substantially the present tool was employed in connection with the salvage of the U. S. submarine "S-48," which went down, stern first, while in a peculiar run of [illegible].

[illegible] The entire craft was submerged, and only after [illegible] work did the crew succeed in elevating a portion of the bow above the surface, thus enabling the personnel to escape by way of the torpedo tube. The wrecker's problem was to attach a suction hose to the boat so that the pumps might drain the vessel's afterbody sufficiently to bring about her refloating. The simplest way to reach the inner hull was by way of the motor-room hatch, 70 feet below water; but the hatch was sealed and locked. The problem was to cut a hole through the center of the cast-steel cover, and then to release the mechanism that held it shut. The torch did its work well and speedily

When plans were made for carrying out the repairs on the Staten Island conduit, the salvage engineer who was largely responsible for the existing subaqueous cutting apparatus realized that heavy cast-iron, with its high remelting point, would require more intense heat to effect the needful fusing. Accordingly, the torch was suitably altered to meet this condition. The device used relies upon the action of an electric arc in combination with a suitable "cutting gas." Just what the latter is is not disclosed. The new instrument is apparently capable of employment at any depth and in the coldest waters where it is at all practicable for a diver to labor for any length of time.

The get-up of the torch is very simple, consisting principally of a single carbon electrode pierced longitudinally by two parallel small tubes through which the gas is fed to the zone of the arc. The quantity of gas can be controlled by the diver agreeably to the depth at which he is working and the particular needs of his job. The current for the arc and the gas for the jets are distributed from the floating base by a hose containing the electrical conductor When the diver has reached his objective, and is ready to begin operations, current is switched on, and he induces the fusing arc by bringing the tip of the electrode within a fraction of an inch of the metal to be attacked. The moment the electrode is moved away from this proximity, the circuit is broken and the arcing ceases. A good deal of skill, born of practice, is demanded on the part of the diver to keep the tool functioning steadily Much of the work performed by the gas is to create a vaporous envelope about the electrode so that the arc can direct a large measure of its intense heat against the metal to be cut.

Under-water torches for kindred service were first tried out by the Germans quite 10 years ago; and the oxy-acetylene gas was fixed in a cup-shaped nozzle which, in effect, was a miniature diving bell. A portion of the hot and expanding gas in the cup tended to push the water outward and to hold it at bay while the central flame acted upon the object to be pierced or severed. At shallow depths, and against comparatively thin bodies of iron and steel, fairly good results were obtained during tests, but the torch had little practicable value in very cold water, at greater depths, or when contending with thicker metallic masses.



The evolution of the under-water metal-cutting torch, showing the main features of the German, the French and the American apparatus

During the war, the French naval authorities made strenuous efforts to adapt the regular above-water, oxy-acetylene torch to subaqueous service, and to this end they endeavored to improve upon the earlier submarine torch of the Teutons. Experimentally, their torch did perform at greater depths than had been possible with the German apparatus; but it seems that the tool did not reach a thoroughly practical stage The stumbling block was the acetylene. This gas ignites explosively when at a pressure of approximately 30 pounds. For under-water work, the pressure of the burning gases must be considerably greater than that of the surrounding water; and as the depth increases beyond 20 feet the action of acetylene becomes very uncertain.

To overcome this difficulty, the French devised a torch which used compressed air in addition to oxy-acetylene, and this air, at a sufficiently high pressure, was projected from an annular opening outside of the oxy-acetylene torch-chamber. This arrangement was counted upon to create a vaporous focus or cavity within which the cutting flame could operate—the pressure of the oxy-acetylene being much lower than if the disruptive action of [illegible] gas alone had been depended upon to hold the water away from the incandescent jet. While [illegible] was an advance, still it seems to have left much to be desired; the effectiveness of the tool was limited by the burning range of acetylene. The maximum depth to which this torch was tested was about 29 feet. In its 1918 form, the torch had to be lighted above water, and if extinguished while submerged it was necessary to return it to the surface for reignition Latterly, it is reported that the French tool can be relighted under water by chemical means.

Plainly, the American torch is a notable advance in the art owing to its simplicity of construction, its dependability, its method of establishing the cutting arc when submerged, and its performance at any working depth. It has reached its present state after lessons learned in applying it to numerous and varied submarine wrecking tasks. The question may reasonably be asked, Why would not power-driven subaqueous cutting tools answer fully as well as the torch? This query has been answered by jobs in which the rival apparatus have been used by skilful men For instance, during the refloating of the U S. transport "America," in 1918, two expert divers took five days to remove by drilling a ⅝ inch plate On the same ship, a similar plate, at a depth of 61 feet, was cut through by torch in a single day's work Later, the wreckers, while engaged on the "City of Lahore," were obliged to use submarine drills because the under-water torch was not at the time available, and their experience then confirmed the results of drilling within the "America"—disclosing the great superiority of the torch.

Method of Breaking Shells of Chicha Nuts

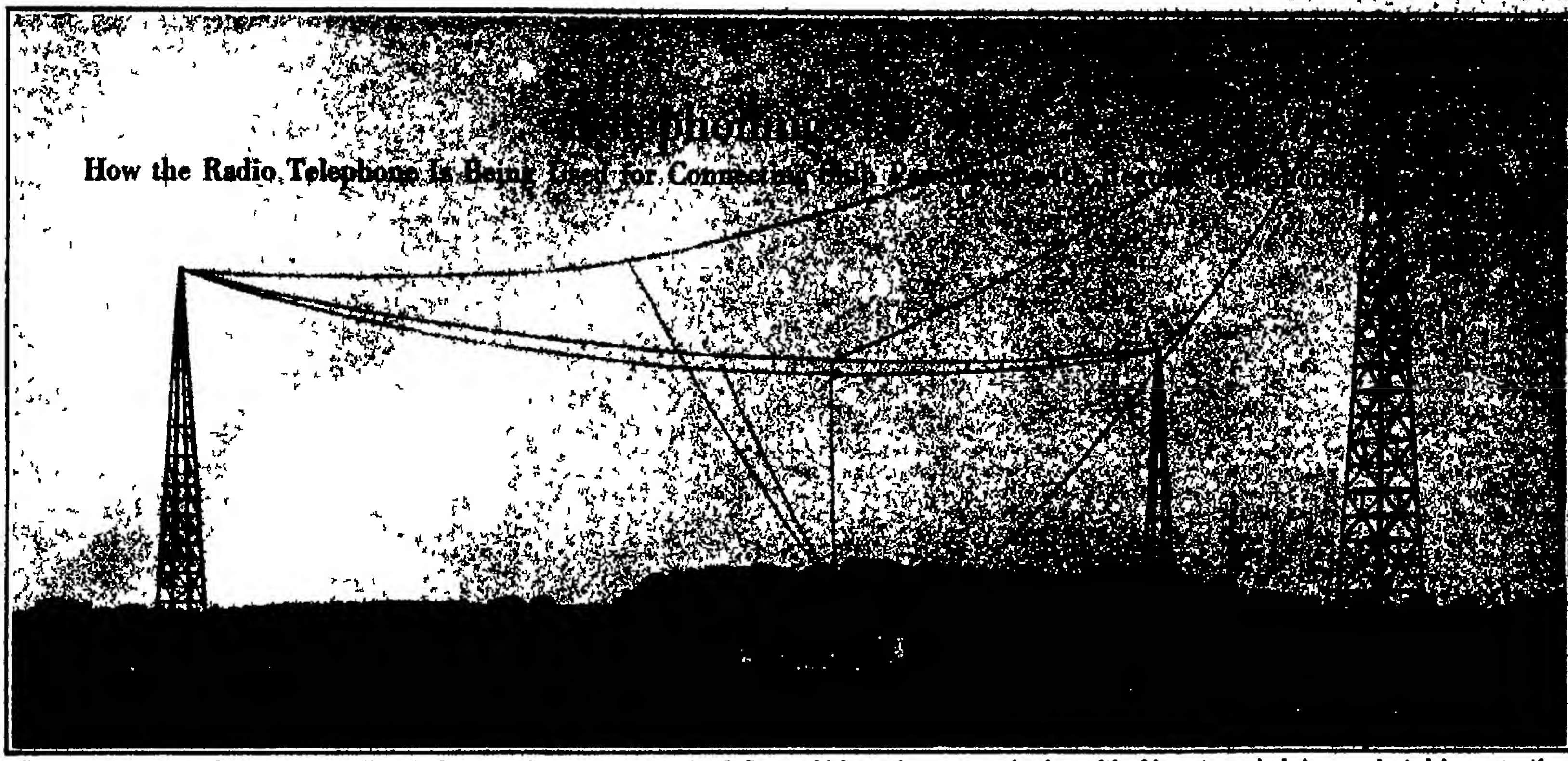
ALL of us know that certain classes of nuts, such as are found on the table at holiday season, are difficult to break, but few of us would believe that in order to crack the shells of certain valuable species, it is necessary to resort to peculiar and original industrial processes.

Chicha nuts, which are grown in certain portions of South America, were used during the war as a source of charcoal for gas masks, and as the kernels are a valuable food, such nuts would meet with a ready sale at the present time. However, great difficulty is experienced in breaking the shells without destroying the kernels, as a load of about 1800 pounds is necessary to crack the outer covering. The attention of the bureau was brought to this matter, and as a result of some experiments, it has been found that such nuts may be broken quite easily by means of liquid air. The nut is immersed in liquid air for about half a minute, which is long enough to make the shell extremely brittle and does not penetrate or damage the kernel. It may prove profitable to install plants for the manufacture of liquid air in the vicinity where these nuts are grown, but, of course, the commercial aspect of the proposition is something with which the bureau has not dealt.

Piping Made of Paper as a Manufactured Article

A FRENCH inventor, M Dalery, proposes to make use of paper on a commercial scale for the manufacture of water piping and the like by an improved process. The pipe is made up by winding paper in a very tight manner, with the use of a suitable adhesive compound The sections of pipe are formed in a machine of the type already employed in certain manufactures, the paper or light pasteboard being wound directly upon the mandrel or shaft of the machine, using a tank containing the adhesive substance, which is placed at a higher level in order to secure a downward feed during the winding operation The last layers are impregnated with tar, then the pipe is given a covering of bitumen as for gas and water pipes. Suitable measures are taken to produce a large-diameter portion at the end of each pipe section, into which is fitted the smaller end of the succeeding section then the joint is made tight by a tar treatment and by winding the joint with a strip of 8-inch tarred fabric Tests were made with the new piping in order to set forth the three principal characteristics which are required, that is, tightness, strength against interior pressure and good preservation As concerns the tightness of the piping several sections were mounted in the vertical position and the bottom was well stopped up, water being placed in the pipe and allowed to stand for 21 days. At the end of this time there was no trace of leakage to the outside of the pipe, so that this test appears conclusive. To ascertain the strength of the pipe when subjected to internal pressure, a section of pipe was stopped up by plugs and was placed in connection with a source of hydraulic pressure by a tube passing through one of the plugs, while a pressure gage was mounted on a tube passing through the other plug. The pipe burst at a pressure of 20 atmospheres, which was a very good result But the joints did not prove to be very strong, and would only support four atmospheres This, however, is a detail and is, of course, subject to improvement. Tests were next carried out as regards the preservation of the piping, but as the element of time is here concerned, these were, of course, more difficult to execute in a satisfactory manner The sections were immersed in a water tank, and at the end of 3½ months a considerable disaggregation was observed due to the fact that the adhesive compound had dissolved in the water It would seem however, that this difficulty could be easily remedied by the choice of a suitable waterproof adhesive substance Besides, the result was largely due to the entrance of water by capillary action through the end of the pipe, which had not been well protected, and on the other hand when in normal use the end of the pipe is not subject to this action. Other tests with the pipe laid in the ground showed very good results as to preservation On the whole, it appears very probable that piping made of paper can be manufactured as a practical article, at least for numerous purposes. Machines must be found to wind the paper in a very tight manner Such machines already exist, and it will suffice to adapt them to the present use A method of this kind appears to be very promising, especially in view of the high price of metal For temporary plants it is evident that such piping might render great services at a small cost. The almost unbreakable nature of this article is a point to be considered, together with its light weight, in the question of transportation. Some of its uses which are more obvious might be mentioned, namely, as piping which is not buried in the ground and is therefore not subject to damage for this reason, then it could be used as a protection for metal pipes against cold, and especially as a steam pipe covering Electric cables could also be protected in some cases. In short, the method is one that deserves careful consideration and thorough investigation.

How the Radio Telephone Is Being Used for Connecting [illegible]



General view of the Bell System radio telephone station at Deal Beach, N. J., at which station communication with ships at sea is being conducted in connection with the regular telephone lines

THE day is not far distant when every passenger steamer at sea will be just as much within reach of the regular telephone system and just as much an integral part of that system as the modern city apartment. There is nothing new in this prophecy: it has been talked about and virtually promised ever since radio telephony came into existence a decade and a half ago. But today we are making very substantial progress toward the early realization of telephony from ship to shore, along with all the other things promised for radio telephony

Already we are telephoning to sea over the regular telephone lines. Experiments are being carried on, and while much remains to be done in the way of perfecting and refining the various details of this combined telephone and radio telephone system the results indicate that the idea is feasible and most likely practical A person talks over the regular telephone line and listens in the same manner as usual The other person on board ship also speaks in the usual manner Aside from occasional interference from other radio transmitters, especially radio telegraph, there is nothing to indicate that the conversation is other than an ordinary telephone conversation

Recently an official of the Bell System was called to the telephone at his residence in New Canaan, Conn, to answer a call from Captain Rind, who was on his ship the "America" of the United States Line as it approached New York At the time, the "America" was still 24 hours from port, or about 370 miles distant

"Hello, this is Captain Rind"

"Captain, this is Mr Thayer of the telephone company I'm up in New Canaan I understand you are three or four hundred miles at sea."

"Yes, we were 370 miles from Ambrose light at 7 30 We expect to dock tomorrow evening at 7 or 8."

"What kind of a trip are you having?"

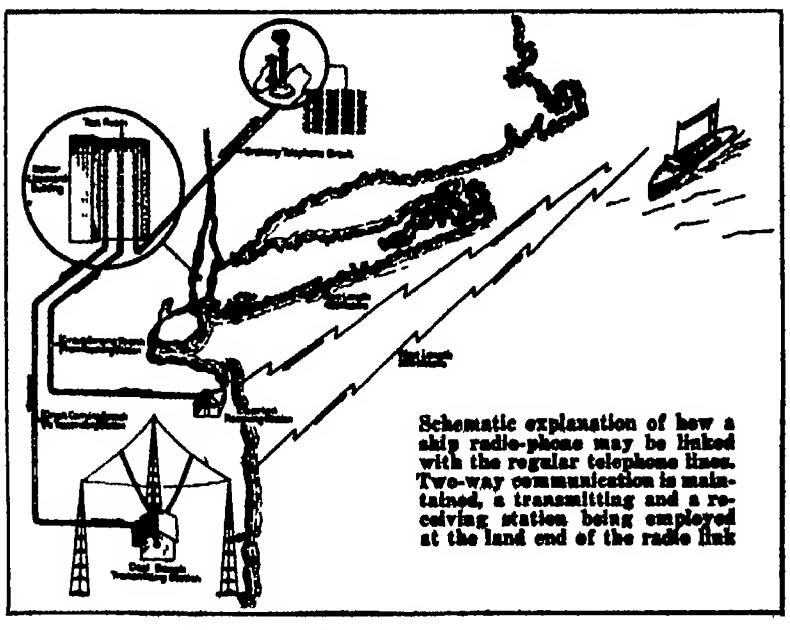
"We're having a good trip for this time of the year"

"Well I'm glad to have had the pleasure of speaking to you I think it is fine that we can meet and talk this way."

That was how the conversation ran Over 100,000 persons heard the conversation, for the radio link, connecting the wire telephone system with the ship radio set, makes use of radio waves that may be intercepted and heard with the usual radio receiving set. It may be that at some future date some combination of wave lengths will be employed to make the radio telephone link more or less private, but for the time being the conversations are more or less public because of the large number of amateur receiving sets within range.

Preliminary to her last voyage to Europe, the steamship "America" had been equipped with a radio telephone set Throughout the eastward trip tests were carried out between the ship and the radio telephone station of the Bell System located at Deal Beach, N J, some 33 miles south of New York in an air line These tests were overheard night after night by numerous radio amateurs along the North Atlantic coast, and led to many questions concerning their purpose Similar inquiries were anticipated upon the return of the ship and it was thought desirable by the telephone officials to advise the public by means of a demonstration before representatives of the press.

The evening of March 5th was selected as the time for this demonstration, since the ship was scheduled to be then between 350 and 400 miles from port, a distance considered to be the fair working range, under normal atmospheric conditions, for the radio transmitters both on board ship and at Deal Beach. The success of the demonstration proved that the time had been well chosen, for, with the exception of 10 or 15 minutes during which the wireless waves were subject to "fading," as the radio engineers say, telephoning between the ship and shore proceeded without the slightest difficulty



Schematic explanation of how a ship radio-phone may be linked with the regular telephone lines. Two-way communication is maintained, a transmitting and a receiving station being employed at the land end of the radio link

The accompanying schematic drawing gives a general idea of how these experiments in ship-to-shore telephony have been carried on. The reader will note that two separate stations are being used on the Jersey coast, Deal Beach being the transmitting station and Elberon the receiving station For those who are more technically inclined, it might be pointed out that the wire circuit was operated on the four-wire principle between Walker Street and the radio stations, and on the ordinary two-wire principle from Walker Street to New Canaan. A hybrid coil and balancing network, such as forms an essential part of all telephone repeaters, established the union between the two- and four-wire circuits.

The steamship "America," belonging to the United States Shipping Board fleet, is a 28,000-ton vessel engaged in passenger service between New York, Cherbourg, and Bremen On the trip of which we are writing she carried a large booking of passengers who, during the progress of the tests, not only manifested considerable interest in them but also expressed in no uncertain terms their willingness to talk with persons on shore should they be given the opportunity These passengers, in turn, had many friends in this country who were equally anxious to communicate with them, indeed, the engineers in charge of the Deal Beach station reported an avalanche of more telephone calls than they took time to count from parties who wanted permission to talk with friends on board One of these requests actually came by telephone from as far west as Chicago.

The demonstration not only brought out the possibilities of ship-to-shore communication, but also illustrated its shortcomings—shortcomings which are, in large measure, characteristic of radio in all its forms. At regular intervals throughout the test, which lasted for over an hour, intelligible communication with the ship was prevented by interference from spark stations, most of which were on vessels at sea, the spark stations near New York very generously having stopped their sending during the period of demonstration. The elimination of interference between stations, all engaged in carrying commercial business, is one of the important technical problems of radio still waiting solution.

Another limitation of the radio telephone was forcibly brought out by the number of telephone calls which came in from persons who said they had simple radio sets in their homes and were listening in on the whole conversation between the speakers on shore and on the ship. A telephone message, once it has been given [illegible]

the radio transmitter for propagation through the air, is virtually public property, and as upwards of one-half million radio amateurs throughout the country know, it is the simplest matter in the world to listen in on such a message. However, there are ways in which secrecy may ultimately be obtained for the radio link of a telephone system.

Moreover, atmospheric conditions exert a marked influence upon the ease with which a radio message travels through space. These conditions vary greatly from day to day and from hour to hour This can well be illustrated by the observations which have been made in connection with the radio link of the telephone system, operating between Long Beach, California, and Catalina Island. This radio link was described in full in our November, 1920, issue, as well as the interesting experiments between the steamship "Gloucester" and Deal Beach, and the regular telephone system. The distance between the mainland and the island is 30 miles, and the sets have been made sufficiently powerful to transmit speech across this distance under the most unfavorable conditions. On the other hand, it has been found that this amount of power is sufficient under exceptionally favorable conditions to make these messages readily audible in New Zealand, 5000 miles away One of the most difficult radio problems the telephone engineers have encountered is the transmission of a fixed quantity of current over the telephone lines in spite of the extremely variable intensity of the radio signals which are to be relayed over these lines.

Another atmospheric phenomenon which is a source of most serious disturbance to radio transmission and which thus far has baffled all attempts to eliminate it, is the so-called "static" Fortunately, for the demonstration we have just described, there was very little static present. Its occurrence varies greatly with the season of the year, and in the northern hemisphere is particularly troublesome during summer Indeed, there are hours and even days together when all but the strongest radio signals are obliterated.

The radio link—the spanning of space between bits of regular telephone system—must come. The difficulties in the way of everyday, practical ship-to-shore communication are numerous and formidable, but they are certain to be brushed aside just as so many other obstacles in radio have been overcome.

Interior view of the radio telephone station at Deal Beach, N. J., showing the operator's desk in the foreground and the antenna connections on the balcony

Pure Cellulose with the Aid of Chlorine

THE manufacture of caustic soda by the electrolytic process is of the highest commercial importance and technical interest, for it enables the production of a very pure product at a relatively low cost. The process consists in passing the electric current through a solution of common salt, contained in a specially devised cell. The products are caustic soda of 99 plus per cent purity and the gas chlorine. The fact that chlorine gas is produced along with the caustic soda is at the same time both an advantage and a disadvantage. Chlorine is a valuable product, both of itself and when converted into bleaching powder by passing it into lime. But the demand for caustic soda is almost always greater than that for bleaching powder or for liquid chlorine, sold as such in cylinders. The result is that when the production of caustic soda is sufficient to meet the demands, the simultaneous production of chlorine gas is too great for the market to absorb. The gas cannot be released into the atmosphere very well, for it is very corrosive and would cause considerable damage to crops, vegetation, buildings, and all metal work with which it came into contact. So much effort has been given to developing additional uses for the gas.

Italy's production of caustic soda has been made largely by plants which use the electrolytic process, and the Italian technologists have been working on this problem. A recent article in *Chimie et Industrie* (1921, 297), by Umberto Pomilio is concerned with the use of chlorine to produce pure cellulose, well suited for the manufacture of paper, from various raw materials, such as poplar wood, hemp and hemp refuse, straw, esparto grass and other vegetable fibers.

Cellulose is the principal constituent of all vegetable matter; of wood, grass, hemp, cotton, the stalks of the corn plant, etc. But in the natural state cellulose is mixed with a large number of other compounds, which do not differ very much from it in composition and properties, but which must be removed before the cellulose can be used to make paper and paper products. Fortunately, these impurities are much more subjective to chemical reagents than the pure cellulose itself, and the methods of preparing the pure product depend primarily on this selective action of the reagents employed.

The use of chlorine as such a reagent is not altogether unique, but its practical application on a large scale with successful results is a new development. Combined treatment with caustic soda and then with gaseous chlorine has been used, but while the cellulose thus obtained is very superior in quality, the yield was too small to make the process applicable commercially Then in removing ligno-cellulose (one of the cellulose derivatives found in many crude cellular raw materials along with cellulose itself) from jute, chlorine has been used in conjunction with other reagents. This process has been criticized not alone for its low yield but equally because a rather poor grade of product is obtained, due mainly to the long-enduring action of the caustic alkali on the cellulose, resulting in its partial decomposition or hydrolysis, as it is called. Again, in separating the cutose and cuticular substances from linen fiber, gaseous chlorine has been used with success.

Several patents have been taken out on processes in which chlorine gas has been used more generally to produce pure cellulose, but these processes have required too costly and intricate machinery to make them of any real industrial importance, or were found to give poor products, due to the fact that the chlorine reacted with non-cellulose substances in the crude fiber and generated thereby large quantities of hydrochloric acid, which had a destructive action on the cellulose itself.

The present process has been used in the Pomilio chemical works since 1919. At the present time ten tons of cellulose are produced a day and the plant is being increased to a capacity of four times that quantity While various crude fibers can be used, most of the raw material is hemp and hemp waste, as the plant is located in Naples, in the southern part of Italy, where hemp is cultivated largely There does not seem to be any doubt that a pure, white cellulose is obtained by means of this process.

Both chemical and microscopical tests are cited to prove that the cellulose is free from all impurities. Paper made with the pulp possessed great rigidity and a marked degree of translucidity, in other words, was of the quality of a high-grade bond writing or printing paper.

The process consists of three operations, soaking in a dilute solution of alkali, chlorination with gaseous chlorine and washing with a weak alkali solution The mechanical operations involved are similar to those used in the ordinary paper mill, and the chemical operations, especially that of chlorination, can be controlled so well that the best yield of the best quality product can be obtained without any great difficulty For every 100 kilograms of crude fiber there are used 28 kilograms of moist chlorine gas, 16 kilograms of coal, 6 kilograms of chloride of lime and 5 kilograms of soda or its equivalent of quicklime The less alkali is used, the more chlorine gas must be used, and inasmuch as chlorine is the product that is to be got rid of, as much as possible of that gas is used, unless the bleaching powder market is strong, then more caustic soda will be used According to the market conditions for these commodities, the proportions of the two reagents can be varied at will and without interfering with the technical efficiency of the process.

Figures are given to illustrate the economy of the process in comparison with the soda-ash process, the sulfate process and others. One of the main advantages is the reduction in the amount of bleaching powder used The water consumption is about the same as that of the other processes Attention is called to the fact that the process can be easily installed in electro-chemical plants which want to use their excess chlorine in this manner, and in large paper plants which possess electrolytic cell installations. There are many points in the process which make it very attractive It appears to offer a very logical and practical solution of the chlorine problem It is stated that the Pomilio Company is now experimenting to see whether it is commercially possible to recover the hydrochloric acid produced in the process, and also whether there cannot be developed some industrial used for the chlorinated derivatives that are obtained therein as by-products.

Unusual Demands for Weather Forecasts

THE work of the Weather Bureau of the United States Department of Agriculture touches the activities of the people of the country in numerous interesting ways, many of which are of enormous economic importance The regular services, such as daily weather reports, hurricane warnings, and information concerning frost, are known to everyone, but some of the special services are so novel as to deserve special notice

During the last year the bureau has supplied valuable information for those taking part in the national balloon race and the international balloon race which started from Birmingham, Ala., September 25, 1920, and October 13, 1920, respectively, and the elimination balloon race at the same place on May 23, 1921, to determine United States entries for the international race to be held in Brussels. Special forecasts were made and weather reports and advices furnished contestants in these races. Special maps were prepared and detailed information supplied daily

Other cases in which weather information was of particular importance were the transcontinental record airplane flights and transcontinental aerial mail race in February and March 1921 the international yacht race off Sandy Hook in July, 1920 United States Army airplane flights from New York to Alaska A great many special weather forecasts have been made in response to the requests of managers of State fairs, local celebrations and the like This form of service is very popular and is increasing rapidly Also, special advices and forecasts were given in connection with pigeon races. Most carrier pigeon racing associations now depend upon this service and do not release their birds until they are assured by the forecasts that conditions of wind and weather are favorable

On the day before the national election last fall special forecasts were issued to the press associations and to the chairmen of the National Campaign Committees and to the Presidential candidates. In addition to this unusual service, many other demands are made upon the bureau at various times. For instance, in October and November special reports were prepared each day for the guidance of the United States submarine naval boats, engaged in salvaging the United States submarine "S 5" that was sunk off Delaware breakwater

Our Point of View

Within the Atom

LECTURES given during March at various American centers of learning by Dr F W Aston of Cambridge made a notable contribution to the general knowledge of the remarkable advances of the moment in physical chemistry. More and more it is coming to be taken for granted that the chemical elements are made up of identically the same stuff, and that they differ only in their structural arrangements. More and more the passage from one element to another which has so dumfounded science when it was first observed taking place spontaneously is coming to be a matter of course and something which we may ultimately hope to control.

There are several cautions which should be observed in this connection, however In the first place, whatever our assurance that we shall be able to convert one substance into another, the offhand assumption that it will be profitable to do this is not justified. As regards actual transmutation, we can today extract gold from seawater, from the air, from almost any rock or earth. We do not however, attempt to extract it save when it is present in quantities above the commercially profitable minimum It is of little comfort to get a dollar's worth of gold from any source at a cost of $1.05. So it will probably be, if not permanently at least for a very long period, with any efforts to convert the commoner into the rarer elements. The question of economics is outside nature's domain, but the man who hopes to get rich by making gold out of lead or copper out of granite or gasoline out of water by atomic transfer must have a process that costs appreciably less than the value of its products. And this the most enthusiastic cannot predict.

The same condition holds with reference to the conversion of atomic energy, or of matter into energy, and here even less attention has been paid to commercial limitations. The chemist is apt to assume that commercial transmutation will not be possible, he is equally apt to forget his traditional conservatism and assume that the development of energy from atomic sources, when once realized, must necessarily be profitable. Actually, it may very well happen that to release 100,000 horsepower we would have to spend more than that amount, and then atomic energy, like transmutation, would be for the laboratory scientist alone.

Another point which is worth emphasizing is that the present trend of science does not in the least contribute to the respectability of alchemy What we are now doing is very reminiscent of what the alchemists were talking about. But we flatter these old dreamers beyond measure when we read into their vaporous words and ineffective attempts at practice any particular significance. They were trying to do something—what, they did not know Their statements are purposely so vague as to mean nothing and hence anything. Any development, in any direction, which modern science might by any possibility make, could without difficulty be tortured into accord with the vague and meaningless phrases of the seekers for the philosopher's stone. Parallelism between what we are now doing and what the alchemists were trying to do is not to be sought without doing the greatest injustice to modern science.

Trouble-Makers and the Treaty

THERE is a certain type of individual—we have all met him—who is never so happy as when he is unhappy He has "grouch" for breakfast, grievance for lunch, and dines sumptuously every day on suspicion, envy and well-seasoned hate. In every sphere of human life you may find these unfortunates; but nowhere do they bulk so big, and blare so noisily, as in politics and in the press. Of the hate-mongers and misery-merchants of the press we have one full-grown specimen in New York, and, alas, some notorious representatives, also, in the halls of Congress. Just now they are doing their best to discredit the noble work which was done by our President and the Secretary of State at the recent Disarmament Conference.

So far as the navy is concerned, they are explaining how that Machiavellian pair, Great Britain and Japan, have "put one over on us" in the matter of naval readjustment. These countries have gained everything, we are told, while these poor unsuspecting United States have been stripped to the bone. Now, it seems like a waste of time to have to run to earth, expose, and kill a lie so palpable as this; but it has been done, and most effectively done, by the Assistant Secretary of the Navy, Theodore Roosevelt, who, in answer to the question as to what the United States gets in the way of benefit out of the Naval Treaty, points out that she gets a navy equal to that of Great Britain, and superior to the navies of the other powers. Furthermore, the United States moves up to this position at a greatly decreased cost, compared to what the cost would have been had naval competition persisted. If the naval programs formerly projected had been carried through, the heavy fighting strength of our navy compared with that of the others, on a basis of 100 per cent, would have been United States 100, Great Britain 106, and Japan 87 As the result of the Treaty the ratio has been fixed at United States 100, Great Britain 100, and Japan 60.

Not only has the Treaty given us a better position than we would have held if the building programs had been completed, but that enhanced position has been accompanied with an enormous decrease in the cost of building and supporting our navy To have completed the 1916 building program would have cost approximately two hundred million dollars a year, and the cost of supporting our navy would have increased by a like annual amount.

Such is the simple truth about the effect of the Washington Conference upon the interests of our navy, and when the public realizes these facts, they will understand what an unpatriotic and malicious course is being pursued by those who are endeavoring to poison the minds of the public against this Treaty, by representing it as having impaired the relative fighting strength of the United States Navy.

Not in any direction whatsoever has the United States been a loser by the Treaty, and in many directions not only the United States but the world at large has been abundantly enriched. A great thing was done when the nations were led to gather round the table and discuss problems which in a former age have been breeders of hatred and war, and to discuss them so frankly, and with such sincerity, that the solution arrived at postpones the possibility of war, at least for a decade, probably for a generation, and possibly for all time to come.

Why not? The misery-merchants and the hate-mongers tell us, as the Germans told us before the war, that war is a biological necessity, that it is inevitable, and so on We believe that statement will be proved to the devil's own lie, and that, as we have learned to substitute reason for force in disputes between man and man, city and city, state and state—so we have now entered upon the last stage of this development, and shall witness the same substitution of reason and law in the adjustment of disputed questions between the nations of the earth.

The Recent Airship Accidents

THERE can be no question that the tragic loss of the "Roma," following all too closely upon the disaster to "ZR-2," has had a profoundly disquieting effect upon the public mind, and has raised a doubt as to whether lighter-than-air ships are practicable and safe. In the presence of such disasters it is easy to fall into such false generalizations, and draw conclusions that are not justified by the facts. Bearing this in mind, we venture to state that there is nothing so far disclosed with regard to the wreck of these two ships which justifies the belief that the theory of airship construction is at fault, or that transportation by this means is a dream which can never be realized on a large and profitable scale.

Although at the present writing the investigation of the wreck of the "Roma" is still being held, and no official statement has been made as to its immediate cause, we venture the prediction that, as in the case of the "ZR-2," it will be found that the disaster was due to a too sudden application of the controls, when the ship was flying at high speed. Air resistance increases approximately as the square of the speed, and if, as has been frequently stated, the "Roma" was being driven with the full power of her six Liberty engines, a sudden depression or elevation of her elevators would bring a proportionately heavy strain upon the ship itself, upon its elevators, and upon the control cables leading therto. These were the operating conditions that brought about the wreck of "ZR-2." In her case it was the longitudal girders of the hull which proved unable to stand up against the lateral bending stresses developed by a sudden reversal of the rudder when she was traveling at high speed. In the case of the "Roma" it is a probable presumption that either the elevators or the cables leading to the elevators gave way

So far as the ship and the medium in which it is sustained are concerned, there is this fundamental difference between a ship of the sea, and a ship of the air—namely, that the ship of the sea, being only partially immersed, is in stable equilibrium, whereas the ship of the air, being completely immersed, is in unstable equilibrium. The ship of the air, like the submarine, can be maintained in the horizontal plane, if it is desired to fly directly in such a plane, only by the proper relative adjustment of the weights and the sustaining gas in the gas bags, and by the proper manipulation of the elevators. Even at that, when high speed is attained the airship has a tendency to proceed on a wave-line course, which is alternately above and below the true horizontal course.

Now the "Roma," according to published reports of eye-witnesses, was flying only a few hundred feet above the ground and at high speed, and it is quite possible that some rather large and sudden deviation from the horizontal but a too sudden and too large movement to the elevators, with the result that something gave way

If our surmise be correct, it follows that, both in the case of the "ZR-2" and the "Roma," the failure was a purely mechanical one, and, therefore, can be provided against by adopting a more robust construction in future ships. The quartermaster, it is true, may in each case have shown a lack of good judgment, but even in the most skilled of men that is liable at times to happen. Therefore, it would be the part of wisdom for the airship designer to provide against failure of the human element, by giving something more than simple stress-diagram strength to such parts of the airship as through temporary lack of judgment or panic in emergency, may be subjected to abnormal stresses.

Doctors and Near-Doctors

THE public is ever impatient of the physician's doubtful diagnosis, of his inability to explain disease in a word and cure it with a word. It is ever eager to welcome a simple statement of why we get sick and how we may get well again. If this statement has any degree of inherent plausibility, it will impose upon large numbers of intelligent people.

A case in point is the newest school of healing, "chiropractic." Every physical process is of course directed through the nerves. These lie in part in the spine, branching off to their destinations. Spinal dislocations lead to pressure of bone on nerve, inducing paralysis and other disorders. Aside from the specific cure which resetting will effect, it is clear enough that spinal massage will be of much general value.

So far, so good. But the chiropractor makes the generalization that all disease, of whatever character, is due to spinal displacements of a [illegible]

Our Point of View

he has invented the name "subluxations." He proposes to cure and to prevent *all* illness by fingering the spine and setting right its subluxations. He treats blindness and deafness in this way, though the nerves to eye and ear never leave the skull. Germ diseases that are too well established to be attacked as such he meets with the explanation that infection proceeds *only in the presence of subluxations*—if we but have perfect spines we may with complete immunity carry capacity cargoes of the deadliest bacteria. The chiropractic novice locates with a touch of the finger "subluxations" of which trained anatomists are able to find no slightest trace. The spines of investigators have been X-rayed before and after chiropractic treatment, with no visible change. As more than an adjunct to orthodox medical practice the thing is absurd.

Now the M. D. is compelled by law to be of good character, to have a common education admitting him to a university of standing; to study medicine for four years or more, to pass a stiff examination in his entire field. Then and only then is he free to "diagnose, treat, and claim to cure" under State license.

Anyone lacking the full equivalent of these medical requirements should be excluded from diagnosis, treatment and claim to cure, in no matter what guise, one who without this training practices in any way on the human mechanism is a menace. We cite a typical case, where a thoroughly honorable practitioner of one of these newer schools was treating a troublesome knee. The case was diagnosed as calling for ordinary manual treatment—massage, to call a spade a spade For six months it got this, and the bone tuberculosis which was at the root of the matter has been diffused throughout the patient's body, so that she is now dying of pulmonary tuberculosis. Treatment without competent diagnosis of the most innocent-appearing malady necessarily involves risk or error as serious as this.

Another aspect is even more vicious. Frankly the chiropractic schools hold out the lure "no preparation needed beyond the ability to read and write." They urge the student to register now, before the State steps in and stiffens the requirements, they guarantee that if he does they will certify him as having met any new requirements which may be enacted before he graduates. An investigator, taking courses at one of these schools, was careful in his final examination in chemistry to answer every question incorrectly — and still he "passed!" Half and quarter hours are substituted for full hours of study to conceal the extent to which an adequate course is not given. Graduates of correspondence schools are certified to practice, though they have never seen the inside of classroom or clinic The testimonial factory at Davenport, Ia, circulated 100,000 copies of a document attesting to a miraculous cure in a case where investigation showed that recovery was had only after the chiropractor had failed to give relief and had been discharged. The recorded cures in any event follow the chiropractor's own diagnosis—which at best is incompetent and at worst is a deliberate exaggeration. The gentle art of "selling" his wares to the prospective patient is a large part of the course offered the chiropractic student, who in one case is recruited by means of street-corner soap-box orators. A member of the New York County Medical Society found a chiropractor who had been highly recommended to be a man whom he had known six months before as a chauffeur.

These are but the high spots. The reason why chiropractic has attracted persons of such caliber is because it affords a quick and easy way to set up a pseudo-medical practice that will earn specialist's fees, without meeting the requirements of honest medicine. As long as such an opening is available it will be used. To prevent this sort of "professional service" from gaining an established footing as well as to protect the individual patient, it ought to be a definitely established principle that no substitute for a doctor may advise or treat without a doctor's consent, unless he has learned as much as a doctor must learn and has learned it as thoroughly as a doctor must. The proposal now made in New York to license chiropractors or exponents of other cults after a rump preparation of a year or two is in every way bad.

President Harding and American Shipping

IF the Fates be propitious, February 28, 1922, will be a red-letter day in the history of American shipping, for it was on that date that President Harding, appearing in person before a joint session of the Senate and House of Representatives, outlined his elaborate program for establishing an American Merchant Marine. On the same day a bill, prepared under the auspices of the United States Shipping Board, was introduced in both the House and the Senate

After reviewing our ship-building efforts during the war, which gave us something more than 12,000,000 gross tonnage, at an outlay of $3,500,000,000, and referring to the abortive attempt of the Government to establish shipping lines and run this great fleet itself, at a loss last year of approximately $16,000,000 a month, the President said that the immediate problem before the nation is to turn the ships, and our experience and aspirations, into the effective development of an ocean-going shipping service As a fundamental requisite for success, the Administration has decided to sell the fleet to private owners at the current market prices, and accept the heavy loss, due to the difference between these and the first cost, as one of the penalties of the war

So far so good, but, supposing that the sale were made, and that this American fleet were in private hands. There is no possibility, under existing conditions, of the American owners being able profitably to operate the fleet. We pay higher wages, provide better accommodation and better food, are obliged by law to carry a much larger crew, both on deck and in the engine room, must provide more life boats and men to man them, and in general are subjected to much higher operating costs than the competing ships of other nations. Manifestly, if our merchant fleet is to show a sufficient return upon the investment, something must be done to equalize the conditions. The one source from which such assistance can come is the United States Government and its Treasury

From the Treasury President Harding advises the payment of $30,000,000 annually to the various shipping companies. That, of course, would be a straight-cash subsidy, and as such it would be the consummation of a policy which the SCIENTIFIC AMERICAN has advocated for the past 25 years. Most of our competitors grant subsidies, and have built up their fleets largely by this means. We can compete with them only if we do the same thing

The President tells us that even this direct aid is insufficient, alone, to offset the advantageous position of our competitors, and he recommends that certain policies be followed and laws passed, which, by relieving the ship owners of various financial obligations to the Government, would still further tend to equalize the situation. Thus, it is proposed that the owners of vessels be relieved of excess profits and other taxes on their shipping earnings, that one-half of the alien immigrants to the United States be carried in American vessels; that Government troop-transport service be abolished, and Uncle Sam's soldiers and sailors carried in American ships, that a Merchant Marine Naval Reserve be established, the members of which will receive pay from the United States in time of peace, in addition to their pay as Merchant Marine seamen, and that joint shipping and rail rates between American ships and American railways be permitted.

Such in its main outline is the shipping bill, and so far as the future interests of the Merchant Marine are concerned, we believe that it will admirably meet the difficult conditions which have brought the post-war attempts of the Government to make use of our great merchant fleet—the second largest in the world—to such ignominious failure.

A Lesson of the Service-Station

GRANTED that the automobile butcher is unreasonable when he drives his car to a mess of junk 50 miles from nowhere, and then expects the mechanically inclined farmer's boy who has started a little garage at the crossroads to locate all its ills and fix them all in half a day Granted that many—perhaps most—of the complaints about the inefficiency of garages in general, and service stations in particular, are the result of ignorance and unreason on the part of owners, and of unstandardization of design where standardization would be altogether feasible. We can afford to grant all this, and more and still have room to wonder in what slaughter-house a lot of garage men and a lot of "expert repair mechanics" learned their trade

We are not without experience of our own and our friends to illustrate all this. But in a recent issue of *Auto*, Mr S F Edge, than whom Britain boasts no more thoroughly competent automobilist, tells a tale of such rare richness that we are moved to substitute it for any of our own A car which Mr Edge was driving developed a curious ticking which he was not able to locate So he took the car in to the manufacturer's service station and put the problem up to the "head tester"—we gather that the American equivalent of this is the boss mechanic, the one man in the place who is supposed to know that particular brand of car backward and forward and inside out This worthy looked it over, and rendered a verdict that there was a broken ball in the fan spindle accompanied by a loose fan belt.

Mr Edge was not more than half convinced, but he proceeded with the car, and the ticking proceeded too. After some 50 or 100 miles of further driving, the car suddenly passed from ticking to a prodigious grinding and crashing familiar to everyone who has ever lost a bearing or a connecting rod while in motion Mr Edge stopped car and engine, and fingered the crank to see what he could discover Three cylinders appeared absolutely sound, the fourth was without compression or other evidence that it was there A little experiment with the starter confirmed this and raised the hope that whatever was loose was sufficiently out of contact with the moving parts of the crankshaft and the three good cylinders to make limping home on three lungs a possibility Mr Edge limped successfully, to the extent of some 25 miles and several moderate hills.

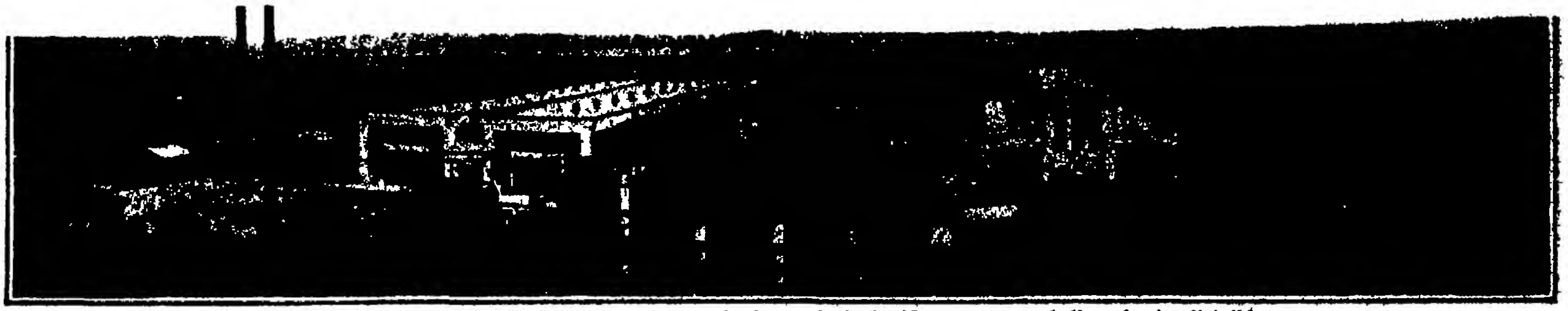
When the car was taken down in the manufacturer's service station to which this trip brought it, the first report was there was nothing whatever to be found of the delinquent piston or its connecting rod—they simply were not there! The suggestion was seriously advanced that this unit had been left out of the car on original assembly, and that Mr Edge had been driving a three-lunger all the time Mr Edge was prepared to accept, if necessary, the implication that the factory was so organized that such a thing was possible, but that he did not himself know the difference between a car that was all there and one lacking a cylinder he could not grant He finally convinced the mechanic that the fact of the car's having gone suddenly bad implied that it had been more or less good So the internals of the car were ordered ransacked in a further search for the missing members—and these were found, in fragmentary condition, tucked away in odd corners of the crankcase and the fly wheel well! The tester who had made the diagnosis casting discredit on the fan assembly was then able to recall that the factory had tried out temporarily a new piston alloy, and had rejected it because of its very tendency thus to crack and fly apart.

This tale is one of those that grows as one lingers over it, fresh absurdities that had previously escaped one cropping out each time one returns to it. We respectfully submit that until something better happens to somebody whose position stamps him as equally an authority and equally to be credited in his narrative, Mr Edge's experience will have to stand as the world's record in service-station attainment of the ultimate zero.

The Industrial Production of Helium

Long Strides in the Past Five Years Toward the Non-Explosive Airship

By S. G. Roberts



Helium Production Plant No. 1 at Fort Worth, from which the Navy now gets helium for its dirigibles

IN a general way the public is aware that helium is non-inflammable—differing radically in this respect from the hydrogen which has hitherto been employed in balloons and dirigibles. The man in the street can no doubt recall that the Government started about four and a half years ago to devise processes by which helium could be obtained on a big scale for aeronautical purposes, but aside from this understanding of the subject, relatively few of the populace have had more than a superficial knowledge of the sources of helium in this country, of the methods employed for its recovery, and of the problem involved in preserving the gas in large quantities when once garnered from Nature's store.

While we had in our possession on the day the armistice was signed 147,000 cubic feet of helium, averaging 93 per cent pure, still it was not until last December that the gas was put to practical service when the "C 7" was thus enabled to voyage from Hampton Roads, Virginia, to the National Capital and back. To get a better idea of the significance of that achievement it is needful only to bring to mind the many occasions when a spark or a flame led to the utter destruction of balloons or dirigibles by converting their contained hydrogen into a violent explosive. Repeatedly we have been told that atmospheric electricity constitutes a continual menace to hydrogen lifted aircraft, and it is a matter of record that the navigator of the British dirigible "R-34" took especial care on that account to avoid thunderstorms during the flights west and east across the Atlantic in 1919. And for war uses, the vulnerability to attack of the hydrogen-filled balloon is especially serious.

Helium is one of a series of rare gases, and, curiously, it was discovered first in the sun by means of the spectroscope as far back as 1868—27 years before Sir William Ramsay found it on this globe of ours. Subsequently, other scientists obtained the gas in small measures in the laboratory and for experimental purposes, and up to 1917 there was in all likelihood not more than 100 cubic feet of the stuff available. The cost of its production at the time ranged from \$1700 to \$2000 a cubic foot.

Helium, next to hydrogen, is the lightest of known substances, and while helium is twice as heavy as hydrogen it is capable, nevertheless, of exerting in a balloon, for instance, an ascensional power of 92.6 per cent when compared with the latter. This is a seeming paradox, but the explanation is a simple one. The buoyancy of a gas is gaged not directly by its specific gravity but by the difference between its weight and that of the air displaced by it. Both hydrogen and helium are so light, judged by the standard of air, that the difference in their lifting power becomes relatively insignificant when applied to aeronautics. One thousand cubic feet of pure hydrogen will raise 75.14 pounds, while a similar volume of pure helium can support a load of 69.58 pounds. A non-inflammable and somewhat more economical mixture made up of 85 per cent helium and 15 per cent hydrogen—which has been proposed for balloons and dirigibles—would have a lifting power of 93.4 per cent of hydrogen alone. In other words, a thousand cubic feet of this combination of gases could sustain a burden of 70.18 pounds.

In 1915, Sir William Ramsay wrote to a former associate in America that the British Government was seeking helium in large quantities for use in airships, and he stated that he had sought unsuccessfully for the gas in the exhaust of coal mine ventilating blowers. This communication reminded the recipient of work done by two of our physicists, in 1907, in connection with natural gas derived from certain wells in Kansas. That gas had burned badly when turned into the public mains, and upon analysis this fault was proved to be due principally to the presence of a marked percentage of nitrogen. But during the testing of that natural gas it was also disclosed that it carried more than 1 per cent of helium. Beyond being a matter of scientific interest at the time it occasioned no comment worth mentioning.

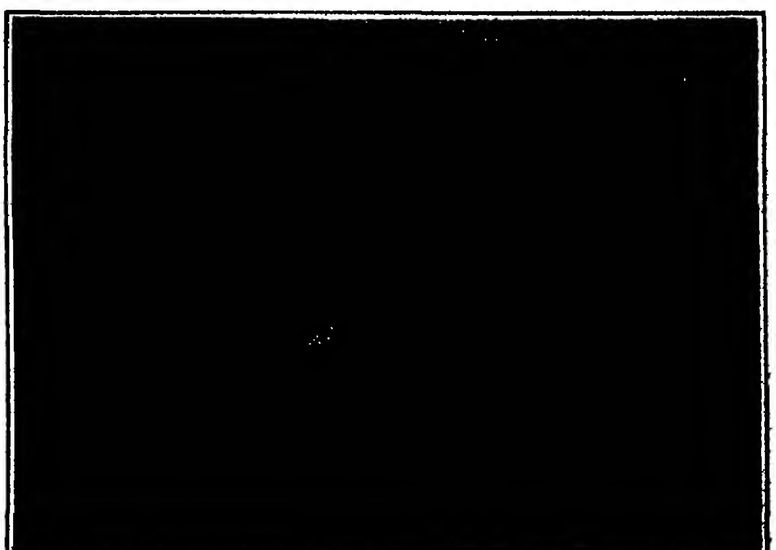
Under normal circumstances, the recovery of helium from natural gas would not have been essayed, for no one would have thought of substituting an extremely expensive element for the low-priced hydrogen. The state of the art of liquefying gases in 1917 indicated that by existing methods helium might be separated from natural gas at a minimum cost of \$80 a thousand cubic feet, and even at this figure the British Admiralty was then ready to contract for more than 100,000,000 cubic feet of the gas—so much did it promise to contribute toward military success. Thus stimulated, and urged on by our own desire to do the utmost to bring the struggle in Europe to a close, the problem was attacked under the general direction of the U. S. Bureau of Mines. Money was allotted generously, and in an astonishingly brief span results were realized that showed we had mastered the fundamental and controlling factors of helium production.

Our war-time activities in this field were, as might be expected, principally of an experimental character, and the plants erected for this purpose were so denominated. These were three in number, and each of them relied upon a distinctive method of extraction. Two of the works were set up at Fort Worth, Texas, and were designated as Plant No. 1 and Plant No. 2, and the third one was built at Petrolia, in the same State, and was called Plant No. 3. Plant No. 1 utilized the Linde process, Plant No. 2 was based upon the Claude process, and Plant No. 3 was arranged to use a truly ingenious departure in the art, the so-called Jefferies-Norton process, of wholly American conception. All of these establishments were supplied with natural gas, containing from 65 to 1.18 per cent of helium, which was tapped from the Petrolia wells, then having a daily output of 15,000,000 cubic feet of gas. This gas, after the extraction of helium and a portion of nitrogen, was then fed into the commercial mains and distributed to Dallas and Fort Worth for heating and lighting.

The separation of helium from natural gas depends fundamentally upon the fractional distillation of gases through compression, which induces heat, and subsequent expansion, which promotes refrigeration—the gases that liquefy at higher temperatures precipitating from the mixture sooner than those that require lower temperatures to bring about this action. The Linde process, originating with Carl von Linde of Germany, relies principally upon what is termed the Joule-Thomson effect, which is promoted by the sudden expansion of a highly compressed gas when issuing from a small nozzle. The progressive cooling resulting from this expansion is sufficient to cause liquefaction of all the gases in natural gas save helium, the one of lowest boiling point. The helium content of the natural gas retains its gaseous state and, in this condition, can be readily drawn off from its liquefied associates.

The Claude process, invented by Georges Claude of France, employs a liquefaction cycle in which an expansion engine is interposed. The Joule-Thomson effect is used, but its value is reduced, inasmuch as the original compression of the gas is somewhat lower than that called for by the Linde system. The maximum chilling is attained through the action of the expansion engine—*i. e.*, the energizing compressed gas, on expanding in the cylinder, and doing work, induces a very decided drop in temperature, and this is ample to liquefy all but the helium in the natural gas.

The Jefferies-Norton process is built, in a sense, upon that devised by Claude and yet is different in some essential particulars. Each unit consists of three expansion engines, and a measure of refrigeration is secured, as in the other methods, by throttling nozzles. The purpose of the newer cycle is to extract the helium by a far more economical use of power. In the Linde system a very heavy expenditure of energy is needed to compress the gas to a high point in order to get thereafter the fullest benefit of the cooling effect of expansion through throttling; and most of this initial power is later on wasted. It is true that the Claude process operates satisfactorily with less primary expansion than the German one—*i. e.*, demands less energy; but again, a large share of this force is dissipated before the cycle is completed. The Jefferies-Norton system, on the other hand, does its work with only a moderate compression of the gas; and much of the power necessary for this service is conserved by coupling the expansion engines to compressors. Thus the engines serve the twofold end of stimulating refrigeration and helping to do some of the compressing. Each of the expansion engines functions at a different temperature, and this permits the hydrocarbons in the natural gas to be liquefied one by one. This



U. S. Navy Blimp C-7 leaving Hampton Roads for the first flight of a helium-inflated dirigible

increase in efficiency is counted upon ultimately to lower costs. We say ultimately, because the Petrolia plant is in an evolutional state and some of its features await further study to insure their proper performance.

The Linde plant started up early in March of 1918, and by September of that year it was turning out on an average of from 4000 to 6000 cubic feet daily of 70 per cent helium; and by reprocessing the gas it was able to raise the product to a purity of something over 90 per cent. The Claude plant became active on the 1st of May of 1918, and before that month was out it was yielding gas of a grade ranging between 60 and 70 per cent helium. By the end of January, 1919, when Plants Nos. 1 and 2 were closed, they had manufactured about 200,000 cubic feet of helium. The Jefferies-Norton plant was run for experimental purposes afterwards, and during the past twelvemonth, for short periods, a product was obtained there carrying a maximum of 49 per cent helium. All of the investigational work at the three establishments has entailed an outlay of about $1,200,000. In return, apart from adding greatly to our technical knowledge, we got a commodity worth, at pre-war prices, anywhere from $250,000,000 to $400,000,000. The helium furnished by the Linde plant cost us $146 a thousand cubic feet; but the experience gained warranted the price, inasmuch as it gave us necessary data upon which to plan Production Plant No. 1, which is now in full operation at Fort Worth, Texas, under the direction of the Navy Department. This installation has a rated capacity of 30,000 cubic feet of helium per diem, and, based upon operating charges only, can turn out helium 92 per cent pure, at an expenditure of $56 a thousand cubic feet. However, the U. S. Bureau of Mines is confident that, when the Jefferies-Norton process is improved and brought to a commercial stage, helium can be procured by it for as little as $30 a thousand cubic feet. While helium even at the latter price would be prohibitive generally as a substitute for hydrogen, and therefore has no immediate prospect of adoption in civil aviation, still the progress made in the art since 1917 is suggestive of what we may reasonably expect in the near future.

The U. S. Geological Survey has concluded an exhaustive examination of our helium-bearing natural gas and has tabulated just where natural gas of this character can be found and given the percentages of helium present in each of these several fields. The richest sources are located in Texas, Oklahoma, and Kansas, measured in a quantitative and qualitative sense, and less promising areas are situated in California, Montana, and Ohio. These are the only sections of the country wherein it would apparently be practicable to undertake the recovery of helium on an industrial scale. In the three States first mentioned there are wells that emit natural gas carrying more than .50 per cent of helium, but most of the wells, taking them in their entirety, yield less than that.

The origin of helium in natural gas is a moot question, and a subject of great scientific interest. It is the belief of many savants that helium is a by product of radioactive processes taking place within the earth's crust, and while this might account for the presence of helium in the atmosphere it does not necessarily explain its association with natural gas. Doctor Richard B. Moore, of the U S. Bureau of Mines, who has had to do intimately with our helium researches, has pointed out that the gas wells in the neighborhood of Petrolia have evolved up to the present time more than 80,000,000 cubic feet of helium. This field covers an area of not more than eight or ten square miles; and he does not believe that within this restricted region there lies underground enough uranium and thorium to emanate so large a measure of helium.

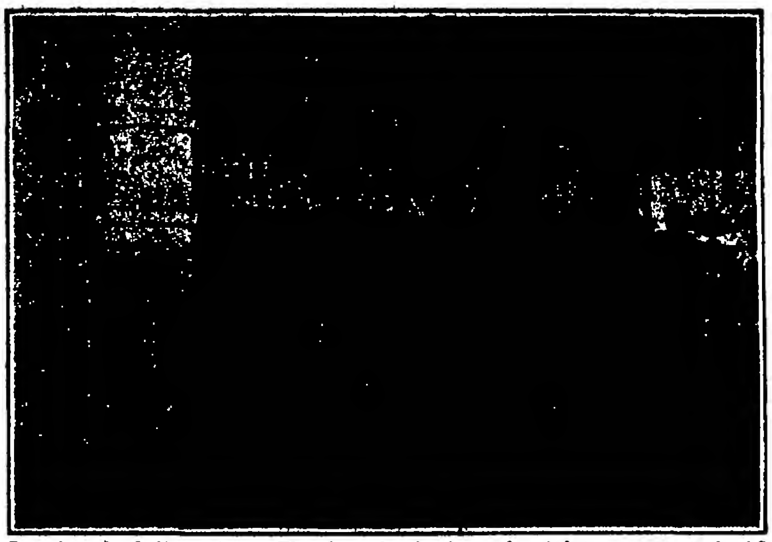
Other students of the problem are of the opinion that much of the helium inside the globe is of primordial origin and in no way connected with radioactivity. In other words, that our subterranean helium had its primary source in the atmosphere, and that it was entrapped in remote sedimentary formations or otherwise absorbed or imprisoned during geological changes. If such be admitted, and assuming that the helium has an inherent tendency because of its lightness to migrate surfaceward, then it is not hard to understand why helium is so often found in the gases issuing from mineral springs and likewise in the natural gas identified with petroleum. Be this as it may, and this aspect of the problem can be left to those of scientific mind, the practical angle of the matter is how to garner this gas and to conserve it before it is lost to us in the free air.

We have it upon the authority of those familiar with our resources that we are allowing to go to waste every 24 hours more than 1,000 000 cubic feet of helium and it seems that if we installed proper collecting facilities within certain sections of the country it would be quite feasible to accumulate daily anywhere from 5,000,000 to 6,000 000 cubic feet of helium. The importance of this becomes apparent when we realize that big dirigibles of the capacity of the ill fated ZR 1" call for fully 2,700,000 cubic feet of buoyant gas. And even if we take the necessary steps to gather helium from Nature's underground supply, how are we going to amass it until required for use?

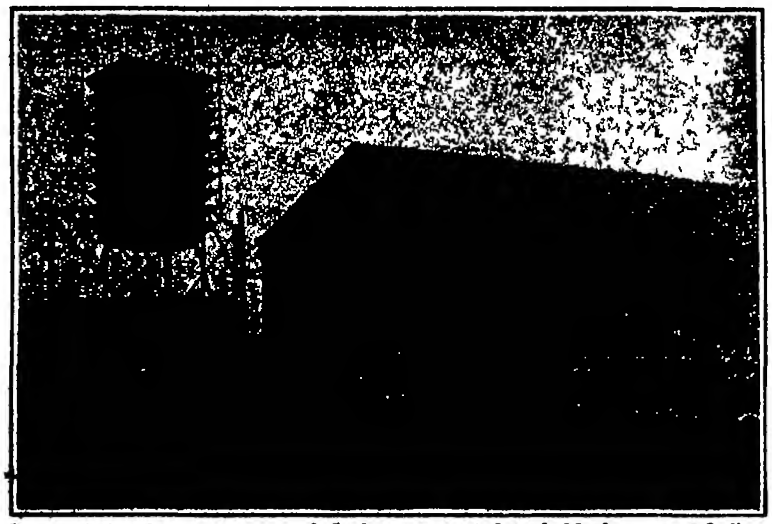
The Government has initiated experiments toward this end. The helium heretofore obtained from natural gas by the experimental works and Production Plant No. 1 in Texas has been stored in steel flasks at a pressure of 2000 pounds, and each container has held 200 cubic feet of the element when expanded to atmospheric pressure. The cost of these flasks has represented a heavy outlay, more than $2,000,000 in fact, and for their preservation additional expense of considerable moment has been incurred. Therefore, researches have been instituted looking to cheaper methods of keeping helium after its extraction from natural gas. Up to date these essays have been confined to storing the gas in a specially prepared chamber located in the Government experimental coal mine at Bruceton, Pa. There is reason to believe that satisfactory results might also be secured by similarly utilizing the abandoned workings of other sorts of mines.

While helium may be found of use to man in many directions, and of peculiar value in studies having to do with very low temperatures, its most promising application seems to be in the field of aerial navigation. Aside from the immediate benefit due to an abandonment of inflammable hydrogen, the adoption of helium in its stead will have a decided influence in promoting commercial transportation by lighter-than-air craft. Helium is less active than hydrogen in seeking to work its way outward through the fabric of the imprisoning envelope, and a balloon or dirigible inflated with helium will, accordingly, retain its buoyancy about a third longer than when charged with hydrogen. Heretofore, it has been customary to place a dirigible's engine in underslung gondolas, so located that the exhaust gases from the motors could be kept well away from the bags charged with hydrogen. As a consequence the propellers have had to exert their thrust off-center being removed some distance from the longitudinal axis of the main body of the craft. Thus, for a given speed, more horsepower has been required to propel the ship than would be needful if the engines and propellers could be arranged in a fashion more nearly akin to that of the power plant of a waterborne vessel. The employment of incombustible helium would render this possible, would do away with the suspended gondolas and their drag or frictional resistance, and would enable the designer to obtain better results from every horsepower of his prime movers.

Repurification units have been developed by the U. S. Bureau of Mines to be used in treating the helium remaining in gas bags of balloons or dirigibles and which has become weakened through atmospheric diffusion. By this means, the partly vitiated helium can be separated from the commingling air at low cost and quickly made again fit for buoyant service. The purpose of this, of course, is both to conserve the gas and to minimize the expense of its adoption in aviation.



Interior of a helium plant. The three flywheels at the right are connected with expansion engines. At the left and rear are the distilling columns into which the purified helium is led



Some of the thousands of steel flasks constructed to hold charges of helium for aeronautical use. The word "argon" is a survival of war-time camouflage

Another interior view, showing the distilling columns that draw off the purified helium. The cylinder at the right belongs to one of the expansion engines used in refrigeration

Modern Miracles of Fishes

Some of the Curious Things To Be Seen by a Close Observer of the Piscatorial World

By R. P Crawford

Photographs by E. A. Sanborn, New York Zoological Society

SEEING fishes in an aquarium is like standing on a corner of Fifth Avenue, New York, and watching the Easter parade of silks, feathers, broadcloth and cutaways go prancing by. The most interesting things about fishes, the same as about people, are often never told.

Fishes aren't so far different from human beings after all. Human nature is very much the same whether in the water or out of it. Life is a business with fishes just as it is with us. Keeping in the social swim in the ocean or backyard pond requires just about as much maneuvering and diplomacy as it does on Fifth Avenue.

Modern-day fishes are quite different from their ancestors. More properly we should say that our ideas about fishes are the things that have changed. Modern day fishes hear and think. There are fishes that actually leave the water and have been known to climb trees. Some fishes when they go courting dress up like a young man. They put on their dress suits for the occasion. Modern-day travelers on ocean liners have nothing on modern day fishes. One of the funniest things is a seasick fish. They have been known to get seasick just like people especially when being transported in tanks on board a steamer. Seals are not fishes, but since they belong to the ocean may be included here. One at the New York Aquarium died a while ago of fatty degeneration of the heart, just as though he had been a Wall Street broker or wealthy manufacturer.

The old-time philosophers and scientific men used to find a whole lot of direful things for sailors to encounter on the deep. There were constant miracles of fishes then. There were octopuses that strangled ships and crews. The ashes of the sea horse mixed with wine, would produce coughing, hot flushes and death and if you were lucky enough to recover, you would forever want to be sailing on the seas. These old time philosophers didn't know all the fishes that lived in the deep and so they imagined a lot of monsters and peculiar things therein for good measure.

The modern day miracles of fishes lie in the modern discoveries about these same fishes that the old time philosophers found so terrifying. Today there are just two parts of the world whose inhabitants are not quite fully known. One is *the deepest jungle* and the other is the deepest ocean. The odds belong to the ocean when it comes to cataloging unknown things, because there is such a variety of minute as well as larger forms of life. There have been explorations of ocean depths, but of course, one can hardly walk about there at leisure and examine everything that comes into view. Knowledge of fishes has always been more limited than that concerning terrestrial animals because the latter are more available. There are few places in the world where any great number of fishes are kept together. By far the most noteworthy is the New York Aquarium in Battery Park, which each year entertains over two million visitors. It is the largest aquarium in the world. But even at that there are no dealers in rare fishes as there are in rare animals, and the aquarium must go out and bring in its own exhibits. It must conduct its own study of individual fishes.

It now seems certain according to the latest scientific investigations, that fishes do take a snooze now and then, even if they can't close their eyes. Recently the fishes in an aquarium were examined after midnight with the light turned low. The fishes had assumed unusual positions and when the light was suddenly turned up they became livelier. Many fishes in an aquarium are to be seen leaning against a wall or a rock, and there is no question but that they are taking a rest. Furthermore, when apparently asleep fishes take on a darker color than when awake.

Fishes have some mental power, for every fisherman knows how difficult it is to catch a fish which has once been hooked and then has got away. Some of them learn to become tame in the New York Aquarium and from time to time their actions resemble play. Scientists now believe that they have mentality, but probably not enough to be able to associate different ideas.

The puffer, shown here inflated, can take in either air or water to make him three times his normal size

In another important respect fishes are quite like the great human family. There are any number of species that are quite talkative. It will be surprising to most persons that fishes make sounds, but a number of them are very noisy. For instance, the fish of the Haemulon family, called grunts, grunt. The drum fish drum, the sea ravens, called Sally Growlers by fishermen, growl like puppies over a bone, while the puffers when held in the hand produce certain sounds like the grinding of teeth. The captain of a boat anchored on the Lower Hudson one night reported that the weakfish croaking underneath the boat were making enough noise to keep a light sleeper awake. Just what these fishes were saying to one another, if anything, is not to be printed here. Perhaps they were complaining about the motor boats keeping them awake.

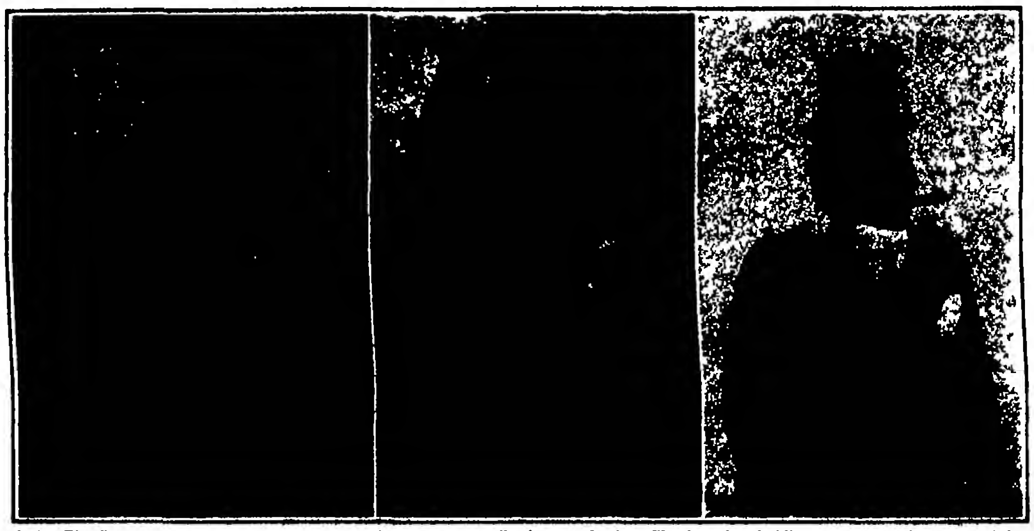
The puffers, which are popular fishes in New York Bay, can claim another point of resemblance to the great human family. They can swell up. When a puffer sees a shark or any other belligerent fish coming *hot foot after him*, he simply begins taking in water or air, and swells up to nearly three times his usual size. He creates such a big impression that the other fish undoubtedly begins to wonder if he would make such a dainty tidbit after all. The puffer is a good bluffer.

Perhaps the most wonderful sort of fishes are those that can leave the water and even climb trees. The climbing perch is such a fish, and it is often on exhibition at the New York Aquarium. It makes good progress on land, and on special occasions will ascend the trunks of trees a distance of several feet. The fish has learned to use its pectoral fins to keep it from keeling over to one side and uses the fins and the spines on the gill covers to pull itself along. The flying fishes of the South Seas, by the way, have large enough pectoral fins to sustain them on flights up to a quarter of a mile.

Many fishes can at will change color. A grouper at one moment may be of pale coloration and show few markings. Then he may suddenly settle to the bottom of the tank and reveal a series of dark bands striping his body. A red coney may turn pale, the lower half of its body becoming almost white. Tropical fish, especially, have this power of changing color, and during the mating season assume daring colorations. Scientists have found that these color changes are brought about by the contraction and expansion of color cells, which lie in deep layers of skin. The iridescence of fishes is due to reflecting tissues.

If you are just a plain ordinary sort of fisherman who once in a while hikes off to a nearby stream or lake, you undoubtedly will be interested in knowing how the novel fishes to be found in an aquarium are secured.

There are no dealers in rare fishes as there are in animals, and since many fishes die off, the exhibits must be replenished to some extent every year. The New York Aquarium shows fishes from as far south as the Bermudas and Florida, from all the adjacent Atlantic Coast and from all the fresh waters east of the Alleghanies. It is quite different fishing for aquarium specimens. You can't use a hook, and just any fish that you pick up won't fill the bill.



Left: The Portuguese man-of-war most conspicuous of the jelly fishes. *Center:* Shark-sucker holding up a pail of water weighing 21 pounds with the unaided power of its suction-disk. *Right:* A curious specimen dressed up to prove that the heads of some fishes are strikingly human in appearance

Some curiosities from the world of the aquarium

A short time ago the New York Aquarium had built to order a 35-foot boat to use in cruising about the adjacent coasts. Every week during *the warm season this* boat is stocked with provisions and a party sets out on a fish-collecting trip. In the bottom of the boat is a well, filled with water, into which the fish are thrown after they have been caught. The well is open so that fresh sea water is kept flowing in and out through slats and wire netting. Two or three days are spent on a trip of this sort, looking for curiosities along the coast.

One of the most remarkable things is the change in the kind of fish available in certain localities. Only a few years ago sea horses were amazingly common all around New York. These cute little fishes, only five or six inches in length, but with tiny heads shaped like those of horses, were so common that the New York Aquarium chose the sea horse as its official emblem or trade mark. The sea horse design was used on stationery, guide books and badges. But today there is not a sea horse to be found in the vicinity of New York, all of them apparently having been killed off in a hard winter a few years back. Sheepshead Bay on Long Island was named for the sheepshead, but that fish is no longer found in this vicinity. The mackerel is reported to be quitting the shores near New York.

Certain fish are usually to be taken in certain places. For instance the green moray is to be found near coral reefs, being a tropical fish Flounders, to which family the halibut belongs, are found where there is a sandy bottom. Blackfishes and cunners are usually taken around old wharves. Fishes migrate much like birds, tropical fishes often coming quite far north for the summer season.

The more ambitious searches for aquarium exhibits mean trips to the Bermudas and Florida On such occasions large tanks are loaded on the steamers and used to transport the fish on the return trips. The water in these tanks must be constantly renewed and usually the steamship pumps are kept busy pumping new water. It is on occasions such as this that the fishes show every symptom of seasickness, getting along very well in the sea itself, but objecting to the rough ride on the boat When fish are to be shipped by boat they are usually not fed for a day before starting, and their meals are also omitted during the first few days of the journey

The New York Aquarium made three attempts to secure some porpoises from off Cape Hatteras. The first two attempts were unsuccessful, the small whales dying each time. Finally a seine 1,000 feet long was stretched not a great distance out When a number of porpoises were behind the net a rowboat at each end was started moving and the porpoises were landed on the beach In order to keep them from dying they were placed in a salt water pond back of the beach, where they were again fished out the following morning and placed on board a schooner *for shipment to New York Of course*, porpoises are warm-blooded, air-breathing animals and not strictly fishes But since they are warm blooded, they always present a real problem in handling, for when placed in a small amount of water they heat it to such an extent as to make it almost impossible for them to live So the water has to be changed *frequently* while porpoises are being shipped, and in the tanks in which they are kept in captivity, the water must be renewed more often than with most fish

Frequent excursions must be made to the fresh-water lakes and streams. For fish to be found near at hand, tanks are loaded on an old wagon and taken to nearby lakes. Then there are trips by rail to more distant points.

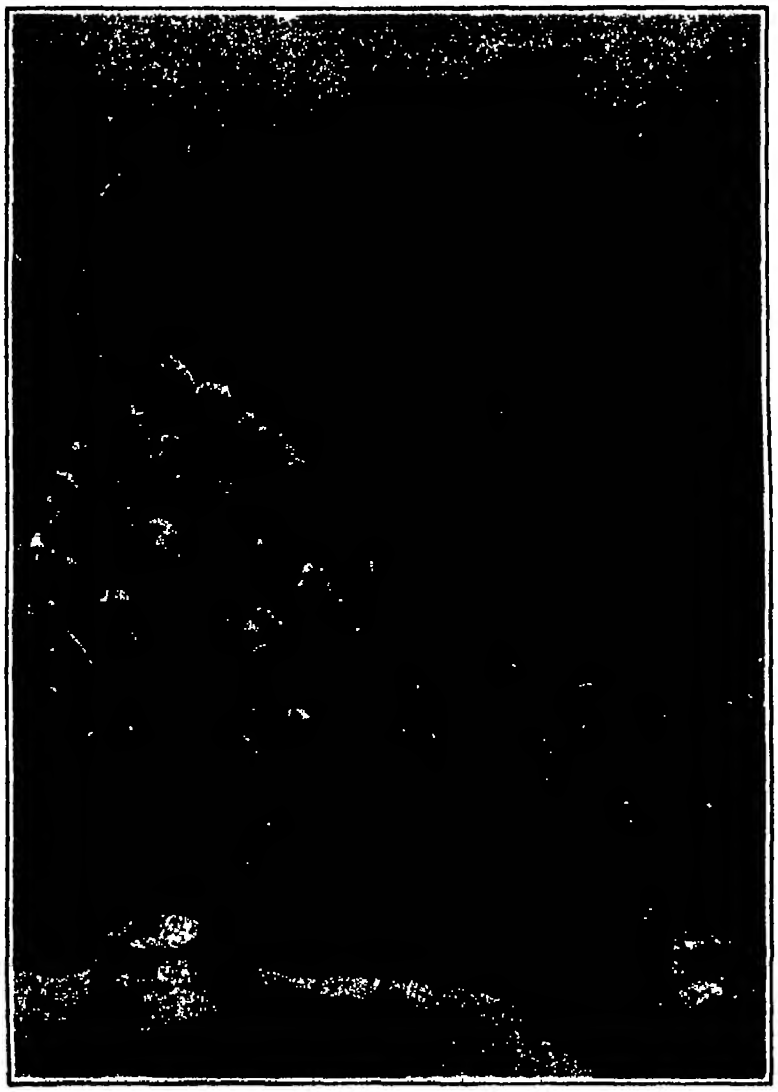
About 250 *different* varieties of fishes and other residents of the ocean and lakes find a home at the New York Aquarium each year There are many fishes that live only a short time and others that are perfectly satisfied with their surroundings year in and year out Efforts have been made from time to time to put herring, *menhaden and butterfish on* exhibition, but they refuse to live in cramped quarters. On the other hand, a striped bass was perfectly content to live in the aquarium for 20 years! A garpike lived for 18 years and a Pacific green turtle the same length of time But a big-eyed herring lived only a week

It keeps one attendant busy half his time cutting up the food for the fish, which consists mainly of other fishes. There are some residents which have to have a special diet. For instance, the little sea horses which used to be so popular required a diet of minute crustaceans called Gammarus, and necessitated the attendants hunting up the fine sea moss on which the crustaceans were found. A sea cow at the aquarium refused to eat lettuce and insisted on eel grass and bread.

Some four different kinds of water have to be kept in circulation. There is ordinary filtered water from the bay for those fishes which are not particular, just so it is salty, then there is sea water for those who would not stand for anything polluted, and, finally, there is both warm and cold fresh water for those fishes requiring it. The sea water originally was brought to the aquarium by tank steamer and this supply has been in continual use ever since, flowing back to a large reservoir through filters. In winter the sea water has to be heated for the tropical fishes and in summer it is equally essential that it be refrigerated for the northern fishes.

Seals always attract attention, but few people know how they are trained. They are not fishes, of course, but they are quite human. They are always full of curiosity and romp about the tank like youngsters. Seals can be fairly easily trained to perform. If they are being taught to play ball, however, the ball must be tossed to them until they accidentally do what is wanted and then they are rewarded with a piece of fish The seal begins to see that if he does the same thing every time he is going to get a piece of fish, and so it becomes a matter of habit. When a troup of seals are traveling on the road, giving performances, there are always two or three understudies who are learning the tricks.

But the biggest miracle of all is that performed by the starfish While most fishes have power to regenerate their fins if they are not entirely torn off, this fish can regenerate its arms if they are torn off Half of a starfish may be destroyed and the other half will grow again In fact, cases have been recorded where an entirely new starfish grew from only the cen*tral group of cells.*



At one time these little "sea horses" were common around New York, but they have all disappeared

Tetralin, the New Motor Fuel

THE world's supply of petroleum is limited. It is becoming increasingly difficult to locate new oil fields, and the old deposits are beginning to run dry It is more apparent each day that substitutes for petroleum and petroleum products will soon enter the market in large quantities, and the sooner this occurs, the longer the petroleum will last

An artificial situation was brought about in Germany, a few years back, due to the cutting off of foreign sources of petroleum and its distillates. The Germans turned to the one mineral which is found in abundance all over the world, and concerning whose possible early exhaustion we need not be worried—coal When coal is distilled to make gas, there are obtained, along with the latter, by-products which are much more valuable and important than the gas itself One of these is coal tar, about which we have heard many times in the past, as the source of raw materials from which synthetic drugs, perfumes and dyes are made The Germans found that they could make a very fine lubricating *oil from coal tar*, and also that it would furnish them with a fuel that could be used to good advantage in the place of gasoline.

The use of benzol, also derived from coal tar for running internal combustion engines has been described in the past, but there is another fuel which can be made from coal tar and which apparently gives much better results. In the distillation of coal tar there is obtained a product, *called naphthalene, which is familiar to all* in the form of tar camphor, used to keep the moths away from clothes When the pure naphthalene is treated with hydrogen gas in the presence of nickel, which acts as a catalyst, there is produced an entire series of compounds according to the number of hydrogen atoms added to the naphthalene molecule. When this number is four, there is obtained tetrahydronaphthalene, or tetralin for *short*, a *colorless liquid* with a characteristic odor, boiling at 205 degrees Centigrade Its resemblance to gasoline lies in the fact that it is fluid at low temperatures and that its ignition temperature is comparatively high (70 degrees) It resembles benzol in that the explosions obtained with it are gentle and there is no tendency for it to take fire in the cylinder

The main advantages of tetralin are its high specific gravity, 0 975, and its equally *high calorific power per unit weight*, which is 11,000 calories per kilogram against 11,000 for gasoline On the volumetric basis, the calorific power of tetralin is 11,300 calories per liter, against 7000 for gasoline and 8500 *for* benzol Because of its high boiling point, it is impossible to use tetralin by itself, but in *admixture with gasoline, benzol and alco*hol in various combinations and proportions, it gives very good results in the automobile engine For example, an equal mixture of tetralin and benzol will start even a cold engine, and there is no difficulty experienced in running the engine with this fuel

There recently appeared a report of some very informative tests made with a 2 1 1 mixture of benzol alcohol and tet*ralin For the details the reader is re*ferred to Auto Technik, 1921 Nos 13, 18 and 19 The engine was of 35 horsepower and the carburetor was of the type used with gasoline fuel The tetralin fuel gave about 20 miles per gallon while the same machine got but 12 miles to the gallon with gasoline The speed reached 55 to *65 miles per hour*

A 1 1 1 tetralin alcohol benzol mixture is also a very good substitute for gasoline in running internal combustion engines The mixture can be used to start cold motors It does not foul the spark plugs and there is no difficulty experienced with its use due to the presence of water in the carburetor The calorific power of this mixture is 8450 calories per kilogram

At the present time the production of *tetralin* is not very great, but its development will be fast, as the hydronaphthalenes have other important commercial uses as well Whether the available supplies of these materials, that is benzol and tetralin, can fill the demands for a motor fuel will depend largely on the development of the by product coke oven and the *use of coke in the place of coal for* industrial and household purposes Eventually, as the petroleum supplies become exhausted, this plan of operation will receive more attention than is accorded it at the present time, although even today there is a movement afoot to educate people to use coke instead of coal

Concrete Houses

THE use of concrete houses is becoming common in various sections of the country In connection with *the general program for the investigation* and improvement of housing conditions now being carried out by the Bureau of Standards, several trips of inspection have been made by members of the staff of that bureau to study improvements in the building of concrete houses The trip recently made included many projects in the vicinity of Pittsburgh, Cleveland, Chicago and Minneapolis. Great improvements, both in the ordinary *uses of the concrete and in the architectural and orna*mental effects obtained, were noted on this trip. It seems certain that some style of concrete house will become very common in the near future

Nelson's "Victory" Makes Her Last Voyage

THE greatest battle of the days of wooden ships was that of Trafalgar—the most noted of the line-of-battleships in that stupendous fight was the "Victory" —and the most famous of the many famous captains and admirals that fought and bled on that great day was the immortal Nelson who, shot down in the hour of triumph on the quarterdeck of the *Victory," expired a few hours later* in her cockpit

Now all of these things happened over 100 years ago, and an appreciative people have so carefully preserved the old three-decker, that she is afloat today and this in spite of the fact that her oaken timbers were fashioned and treenailed together over 150 years ago or, to be exact, in the year 1765. However, the ravages of time and weather tell, and despite all her staunchness, and the loving care with which she has been preserved, the old craft is in a bad way Hence, it was recently decided by the Admiralty to place her in one of the older and smaller drydocks, known as No 2 at the Portsmouth Navy Yard, and give the hull a thorough examination If the bottom timbers are found to be too far gone to permit of the ship remaining afloat, or to warrant reconstruction, the "Victory" will have the little stone dock all to herself as her final and permanent resting place

When she was docked and unwatered, it was found that much of the copper on her bottom had been displaced, and *that there was some decay* of her timbers. At the present writing no detailed report of her condition is available It is to be hoped, because of the fame of the great sailor—a fame that has reached far beyond the limits of the British Navy itself, and is nowhere more gladly recognized than in our own United States Navy—it is to be hoped that the grand old ship may be preserved for many generations to come

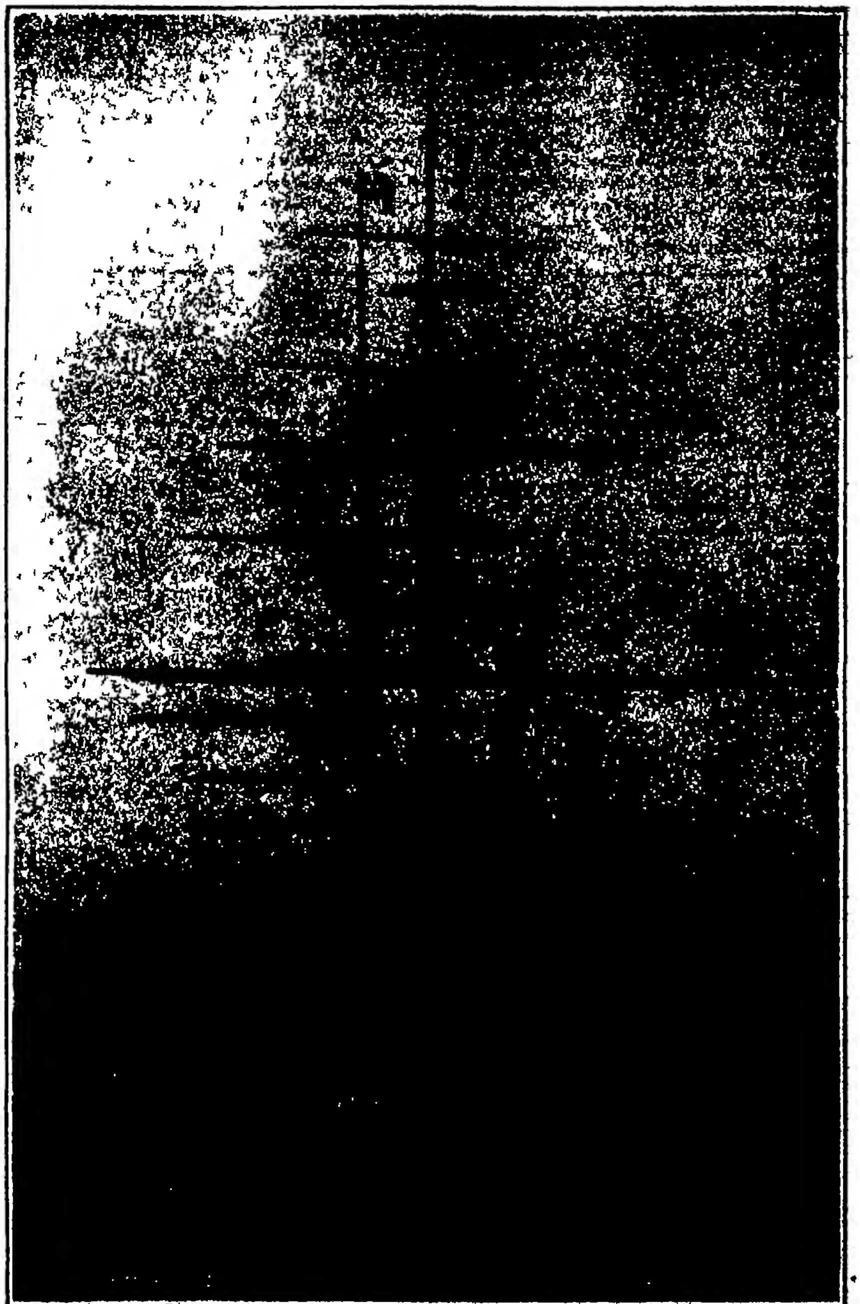
Although the three-decker line-of-battleship of the Eighteenth Century was a dignified impressive and highly picturesque object, she was not a big vessel, judged by modern standards. Thus, we are told that such ships of 100 guns were, in the year 1720, 174 feet long by 51 feet in the extreme breadth, and that they measured about 1500 tons and that in 1745, or just before the "Victory" was built, a three-decker was 178 feet long by 51 feet in breadth, and measured about 2000 tons. The latter figures were exceeded in the "Victory," which was 186 feet on the gun deck, 52 feet broad, and of 2162 tons measurement In the same period the 100-gun ship carried a complement, including officers and men, of about 850

These ships were built of oak and, because they were built in the open, and many of them, due to the urgent demand, were built of absolutely green timber, their useful life was often of short duration, some of the ships being unserviceable after 10 or 15 years. This happened, of course, only under conditions such as obtained in our own war, when we were slapping ships together in any old fashion, in answer to the demand for "ships, ships, and yet more ships."

However, when there was no urgent rush, and seasoned timber could be used, these old battleships proved to be exceedingly staunch and of long life, as witness the "Victory," built in 1759. They were constructed of selected oak, well seasoned, and the scantling was to our modern eyes of enormous dimensions. It is a curious fact that the fastening was by means of treenails instead of by metal spikes or bolts. The diameter of the treenails, we are told by Chatterton in his delightful book "Ships and Ways of Other Days,' was determined on the basis of one inch for every 100 feet length of the ship. The bottom below the waterline was covered with tarred brown paper over which was nailed a sheathing of thin copper plates.

We show a longitudinal section of a typical three-decker of that date. The guns were arranged in rows along her three decks, the lower gun-deck being a little above the waterline. These decks ran from stem to stern, and there was also a forecastle-deck forward and a quarter-deck aft. Below the lower gun-deck were coiled the huge hemp cables, 730 feet in length and over 8 inches in diameter Here also were the powder magazines, stores, etc. Nelson painted his ships black with a yellow stripe along each line of ports. A checkered effect was produced by painting the ports black. A "first rate" carried either 32- or 42-pounders on her lower gun-deck, 24-pounders on her middle deck, and 12- or 6-pounders on her upper deck. On the forecastle and quarter-deck were 6-pounders.

The masting and the standing and running gear of an old-line-battleship were on a grand scale; there were no double topsails, nor were there skysails; but the yards were larger than anything used, even in the later days of the Merchant Marine or the era of the clipper ships. One of the largest French battleships carried a mainyard 125 feet in length, and yards of 100 feet were not uncommon. However, because of their bluff model these grand old ships were slow sailers, even with started sheets. It was all they could do to hold their own when on a wind.



Nelson's famous ship, the "Victory," upon which he died at the Battle of Trafalgar, entering a drydock at Portsmouth, in which she will rest permanently. Built in 1759

Longitudinal section through a battleship of the period when the "Victory" was constructed. The ships were built of selected oak and of great solidity and strength

An Injustice to the Krupp Works

THE Krupp works, of Essen, call our attention to a statement in our November issue among the "Miscellaneous Notes," to the effect that they had at the time three howitzers under construction, also to a "Patent and Trademark Note" in the December issue stating that this firm had applied for French patents on eight inventions pertaining to guns, gun mounts, etc.

Messrs. Krupp feel that these items are apt to spread the impression that they are acting contrary to the stipulations of the Versailles Treaty. They accordingly request that we give space to the explanation that at the moment, three 28-centimeter howitzers, which had been purchased from the Krupps by the Brazilian Government before the war, are being mounted at Essen, with the express permission of the Entente and under the supervision of the Interallied Control Commission. Besides these three guns, it is explicitly stated, no war material has been made at the Essen plant since the conclusion of the treaty

With regard to the patents mentioned, it is pointetd out that necessarily the Krupp firm made numerous inventions during the actual period of the war, and that at the time it was obviously impossible to protect their rights in these inventions in countries which were then at war with Germany It is the desire to protect themselves in the proprietorship of these inventions that has led to the filing of the patents in question, and the very cogent inference is suggested, that if the Krupps were at present engaged in war-like activity, the last thing they would do would be to reveal this fact by applying for patents in the Entente nations. We are very glad to print this explanation, and to note the careful attention which is apparently being given by the management of the Krupps to the contents of the SCIENTIFIC AMERICAN.

Observations of Star Colors

THE Vatican Observatory has just published four volumes dealing with observations of star colors on Schmidt's numerical scale (modified by Osthoff) Three of the volumes are separate catalogs, based respectively on the observations of Benedetto Sestini, S. J., at Rome (1844-46), with revision by J G. Hagen, S. J., of Friedrich Krüger at Aarhus, and of Heinrich Osthoff at Cologne. The fourth is an index catalog, combining the results of the first three, and adding the Harvard magnitudes and spectral types. The colors, on the whole, follow the spectral types closely; there is this physiological effect, discussed by H. Osthoff: a bright star is estimated as whiter than a faint star of the same tint; he investigated this by observing bright stars with sectors of various angles over the object glass, and found that it averaged 0.3 color-unit per magnitude. Owing to this effect, the photographic determination of color-index has advantages over the optical method.

Sugars of Great Price

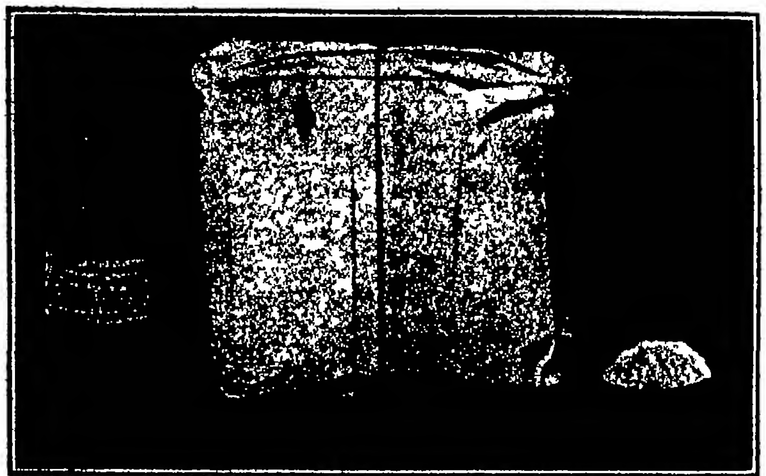
Some Rare Varieties, of Special Uses, Worth More Than Their Weight in Bullion

By James H. Collins

SUGAR at $250 a pound? Yes, it is now on the market for those who want it. Not many people are direct buyers, yet everybody buys it indirectly

It is called "trehalose," one of the scarcest and most expensive of a very interesting line of products developed in recent years by American chemists—the rare sugars. Put up in little ten-gram packages at $10, its price in gold for that quantity weighs about 240 grains, and ten grams of sugar 155 grains. It is worth virtually one and a half times its weight in gold. Even by the troy pound, it costs more than 12 ounces of gold.

This particular rare sugar was originally known as "mycose," or mushroom sugar, because it is found in ergot, a microscopic fungus. Berthelot, the great French chemist, first prepared it from trehala manna in 1859, and some idea of its scarcity is gained when one knows that this manna, the excretion of an insect found in Persia and Turkey in the form of cocoons, consists chiefly of starch, sugar and gum derived from a species of globe thistle upon which the insect feeds. Within the last two years, it has been found in the resurrection plant that grows abundantly in our Southwestern states. This is the familiar plant sold as a curiosity, apparently dead, but coming to life when placed in water Containing two per cent of trehalose, American chemists found a more abundant material from which to make it commercially—abundant in the sense that two or three pounds of this sugar yearly will take care of all their customers.



The bag contains a pound of cane-sugar—about five cents' worth. The bottle holds ten dollars worth of trehalose, and fifty cents' worth covers a half dollar to the extent shown at the right

Sugar—the table variety—versus trehalose

What does the stuff look like—and what is it used for? Just a fine, white crystalline powder, sweetish but not sweet in taste, and, like all the rare sugars, used in the delicate identification work of the bacteriologists.

We all speak familiarly of bacteria There is the old joke about them being called germs in Germany, parasites in France and microbes in Ireland. However, even to the bacteriologist, the majority of them are invisible under the highest power microscope If we first think of the infinite variety of plants in a tropical jungle and a botanist turned loose to identify and classify them and then think of the bacteria as a microscopic and sub-microscopic botanical world, as infinite in its variety, and the bacteriologist turned loose to identify a few thousand of them in one short life—then we get the bacteria into some perspective.

To identify many of them, the bacteriologist must find something upon which they will grow, and they alone, for he cannot see them. Planting his particular bacteria upon some "culture" like one of the rare sugars, which is their congenial garden soil, he raises an invisible crop. Injected into a rabbit or a guinea pig, this culture produces symptoms associated with that particular kind of bacteria and the identification is complete.

Even were it cheap, trehalose would not do for home brew, because it will not ferment with ordinary brewers' or bakers' yeast, but certain wild yeasts are said to ferment in it, and some of those wild yeasts—which are bacteria—may be of great importance to man. If benign, they will perhaps improve his products, enrich his diet, or cure his maladies, and if they happen to be malign, they will spoil his goods or crops, make him sick—even kill him. A rare substance like trehalose may be the only means by which they can be studied. Because pure trehalose has been almost unobtainable until now, very little bacteriological research has been done with it, and so it opens up a virgin field to the scientific investigator.

You will hardly buy "raffinose" at $150 a pound, or "[illegible]" at $100, or any other of a dozen or more rare sugars ranging down to "saccharose" at $1.35—[illegible]. Because a pound of ordinary table sugar made chemically pure for [illegible] purposes costs $1.50. But indirectly you are buying these products as part of the scientific research work you support as a taxpayer, a contributor, or maybe a patient

The rare sugars have been developed chiefly through the scientific research of American chemists, and they are entitled to the sole credit for producing them commercially Before 1914, German chemists had failed to produce them in chemical purity on a scientific scale—some of them they couldn't produce at all.

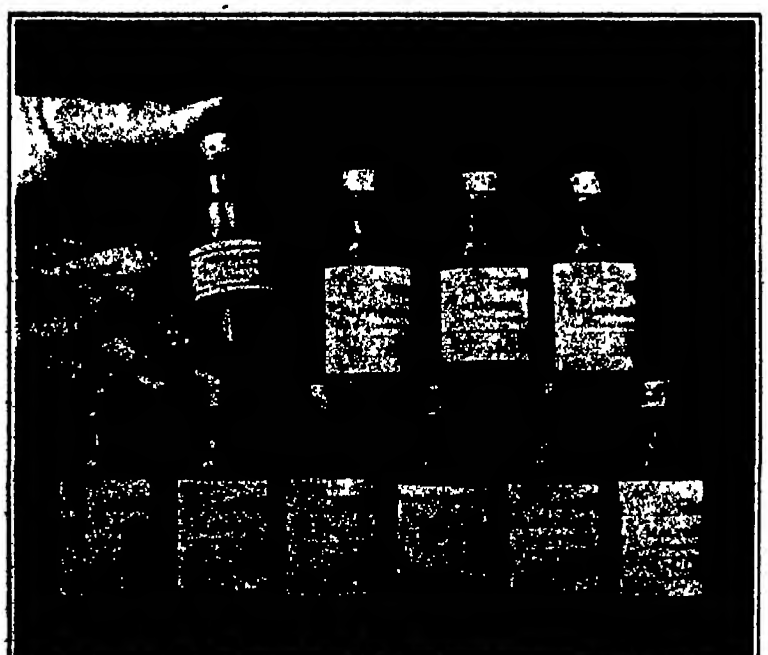
American research in this little-known field was begun by chemists working for Uncle Sam Their job, at the outset, was to study problems connected with the production of every-day sugar as we know it in the sugar bowl and in syrup With a number of assistants, Dr C S Hudson began this work seven or eight years ago in the carbohydrate laboratory of the United States Bureau of Chemistry Cane syrup producers in the south were having trouble—people complained that their syrup frequently fermented or crystallized There is an enzyme known as "invertase," which can be mixed with syrup to prevent that, provided it could be made cheap enough It is found in many yeasts and other fungi as well as pollen grains, beet root and other sources. It is a ferment or "enzyme" This work with invertase directed attention to the rare sugars, and the government chemists went after them, passing from the study of practical problems to pure research Some of the rare sugars were already known as laboratory substances, but methods of isolating them were vague and uncertain In most cases, they had not been rendered pure, and in no case had they been brought to the point of manufacture and made available for scientific workers. Better methods were devised for isolating these known sugars, and later making them in quantity Other rare sugars were discovered by members of Dr Hudson's staff. One young chemistry B S., who had gone into the laboratory right after taking his degree, found these rare sugars so interesting that he specialized in them, carving out a profession for himself The government's carbohydrate laboratory published its results and went back to practical sugar-bowl problems, most of the chemists participating in the rare sugar hunt leaving the government service for work far from rare sugar fields. But T Swann Harding, the young B S. who found these rare sugars fascinating, kept on seeking ways of manufacturing them, and attracted the attention of a pharmaceutical concern far-sighted enough to undertake their commercial development Today, Mr Harding is not only the chief authority in his unique profession, but practically the only specialist in his line—to paraphrase Louis XIV, the profession, it is he!

"It is not a large nor an immensely profitable line yet' he says, "but for whatever it is worth I am it—living proof that a brain, no matter of how low horsepower, will get somewhere in eleven years of specialization"

As an outcome of his work the past three years, the chemical story of more than one rare sugar brought down to date winds up with a reference to his work

In the sugar bowl is only one member of a large family of organic chemicals, known by the word "sugars There are dozens of them and new ones are being discovered every now and then Like all organic chemicals, they occur in systematic groups and these groups are named according to the number of carbon atoms occurring in the molecule Thus a 'hexose" is so called because it has six atoms of carbon

The majority of the rare sugars are rare indeed. They have been made in the laboratory in minute quantities, studied to some extent, but remain chemical curiosities. About fifteen of the rare sugars already have some commercial importance, and others will eventually be added For rare sugars are constantly being studied chemically and bacteriologically, and new uses found for them every little while They are in constant demand in the scientific world though they were never available commercially until two or three years ago



Ten of the rarest sugars. The group is worth thirty dollars, which would buy a quarter-ton of ordinary sweetener

The first rare sugar studied by Uncle Sam's chemists was "raffinose," which is the second most expensive at $150 a pound It really consists of three simpler sugars and can be partially broken down to 'melibiose,' and "levulose' or wholly broken down to "galactose," 'glucose' and 'levulose' It was first found in a eucalyptus, described by Mudie in 1832 Johnston first made the sugar in 1843, calling it eucalyptus sugar Loiseau crystalized it from sugar beet residues, calling it raffinose from the French word 'to refine" in 1856. Ritthausen isolated it from cottonseed meal in 1884, calling it "gossypose." A year later Tollens suggested that all these sugars were the same thing, and so it proved. Hudson and Harding evolved a method for making it in 1914, and Harding later devised a method of manufacturing it in commercial quantities. At $150 a pound, the raffinose in our cottonseed meal alone would, in one year, more than pay off our national debt, for it is worth $30,000,000,000. But it would cost more than the national debt to extract it, and a few dozen pounds yearly are all the scientific world requires.

(Continued on page 362)

Automatic Train Control Made Obligatory

What the Recent Action of the Interstate Commerce Commission Means to Forty-Nine Railroads

By C. H. Claudy

THE recent action of the Interstate Commerce Commission in calling upon forty-nine of the leading railroads to install the automatic stop on the sections of their roads where the traffic is densest and most liable to accidents, is one of the most important acts of that body to safeguard the traveling public. Fortunately the practical inventors of the United States have so far anticipated this action of the Commission that there are today several systems of automatic stop which have been made the subject of exhaustive tests on the leading railroads of the country. In view of the far-reaching effects of this ruling of the Interstate Commerce Commission, we have decided to publish a series of articles describing the most successful of the safety-stop systems. The first of these will appear in the June issue.—EDITOR.

FOR as many years as inventors have claimed to be able to produce a device which will automatically control the speed of a train, or stop it if the engineer fails to see the signal, railroads have contended that the plans proposed were impractical, that they wouldn't work in bad weather, that they were too expensive, that they wouldn't increase safety materially, and that they were unnecessary anyway where block-signals were employed. A similar categorical set of objections has been urged against every revolutionary invention, air brake, automatic coupler, linotype, automatic telephone exchange, etc.

But the old order changeth and giveth way to the new, and the new in this matter is literally an "order" from the Interstate Commerce Commission (dated January 10, 1922) to 49 of the leading railroads of this country to show cause on or before March 15th of this year why they should not be required to install automatic train control on or before July 1, 1924.

In spite of the fine record of some of the railroads, of hundreds of thousands of passengers carried yearly without a fatality, no one seriously questions the fact that American railroads take a heavy toll of lives and limbs every year, and for years inventors have been clamoring that their automatic train control devices would largely decrease such toll. Now we are to see whether or not modern science can stop some of the wicked loss of life, this order of the Interstate Commerce Commission to those enthusiastic over automatic train control appears as bidding fair to be as revolutionary in its results as was the invention of the air brake.

The Interstate Commerce Commission has not been led to issuing this order arbitrarily or suddenly. From 1907 to 1912 the Block Signal and Train Control Board of the I. C. C. has been operating, as a result of a Congressional resolution, and since 1912 the I. C. C. Bureau of Safety has continued such investigations. As a result of 14 years of labor the I. C. C. has come to the conclusion that automatic control of trains is practicable, that the use of automatic train control devices is desirable as a means of increasing safety, and that the development of automatic train control devices has reached a stage warranting the installation and use of such devices on a more extended scale. The successive investigations with their satisfactory results, and the recognized obvious need for some such device, resulted in the inclusion of a section in the transportation act of 1920 which places upon the I. C. C. the duty, after investigation, of ordering the installation by the carriers of automatic train-stop or automatic train-control devices which comply with prescribed specifications and requirements. That section, now section 26 of the interstate commerce act, provides:

"That the commission may, after investigation, order any carrier by railroad subject to this act, within a time specified in the order, to install automatic train-stop or train-control devices or other safety devices, which comply with specifications and requirements prescribed by the commission, upon the whole or any part of its railroad, such order to be issued and published at least two years before the date specified for its fulfillment."

Engineers will understand the difficulty which faced the I. C. C. in promulgating specifications for a device of this kind. Such specifications must be all-inclusive, and yet no one of them must be contradictory of another, either in wording or in results. Not one more specification than necessary must be included, in order that as wide a latitude as possible be given railroads in choice, and yet not one too few must be stated, in order that the device selected be sure to be adequate to the work to be performed.

The definition of automatic train-stop or train-control devices adopted by the I. C. C. is as follows:

"A system or installation so arranged that its operation will automatically result in either one or the other, or both, of the following conditions: First.—Automatic Train Stop.—The application of the brakes until the train has been brought to a stop. Second.—Automatic Speed Control.—The application of the brakes when the speed of the train exceeds a prescribed rate and continued until the speed has been reduced to a predetermined and prescribed rate."

The I. C. C. specifies that all devices adopted must meet certain general requirements: All automatic train-stop devices must be effective when the signal admitting the train to the block indicates "stop," and so far as possible, when the signal fails to indicate existing danger conditions. All automatic train-control or speed-control devices must be effective when the train is not being properly controlled by the engine man, and all automatic train-stop, train-control or speed-control devices must be operative at braking distance from the stop-signal location if signals are not overlapped, or at the stop-signal location if an adequate overlap is provided.

The apparatus of train-control devices acceptable for installation under this order must be so constructed as to operate in connection with a system of fixed block or interlocking signals, if conditions require and so inter-connected with the fixed signal system as to perform its intended function, in event of failure of the engineer to obey signal indications and, so far as possible, when the signal fails to indicate a condition requiring an application of the brakes.

Train control apparatus must, so far as possible, perform its functions if an essential part fails or is removed, or a break, cross or ground occurs in electric circuits, or in case of a failure of energy. Indications of the fixed signal must depend, so far as possible, upon the operation of the track element of the train control device, and the proper operative relation between the parts along the roadway and the parts on the train must be assured under all conditions of speed, weather, wear, oscillation and shock.

The release of brakes after automatic application must be impossible until the train has been brought to a stop, or its speed been reduced to a predetermined rate, or the obstruction or other condition causing the brake application removed, yet it must not interfere with the application of the brakes by the engineer or impair the efficiency of the air brake system. It must be operative when the engine is running forward or backward, and when two or more engines are coupled together, or a pushing or helping engine is used, it must operate on the engine from which the brakes are controlled.

A very important provision requires the apparatus to be so constructed that it will operate under all weather conditions which permit train movements, and of course, it must conform to established clearances for equipment and structures. Neither shall any installation be made that constitutes a source of danger to employees or passengers.

The I. C. C. brings forth very clearly in its report the fact that, while the order will undoubtedly cause a large expenditure of money, there is to be expected a compensating gain of no small amount. For instance, I. C. C. accident reports indicate that from 1909 to 1917, inclusive, 12,[illegible] head-on and rear-end collisions resulted in damage to railroad property alone of over nineteen million dollars and in 2454 deaths and injuries to 87,[illegible] people. During the two and one-half years from January 1, 1918, to June 30, 1920, inclusive, there were [illegible] such collisions resulting in the deaths of [illegible] persons and injury to [illegible]. Railroad property was damaged [illegible] million dollars worth. If to the large property loss the death losses and the damages paid for injuries be added, the total rises to enormous figures. Had an amount equal to the total losses to the carriers been expended in the installation of automatic train-control devices, many thousands of miles of road could have been equipped.

That the contention made that automatic train control is not needed where block systems, or interlocking systems are in use is not borne out by the facts has been strikingly brought out in statistics of the I. C. C. Bureau of Safety for the fiscal year ending June 30, 1921. During these twelve months 6[illegible] collisions and [illegible] derailments were investigated. The collisions resulted in 194 deaths and injury to 849 people. The derailments caused 77 deaths and injury to 518 persons, a total of 271 killed and 1367 injured. Twenty-six of these collisions occurred on lines operated by the block signal and of these 17 happened in spite of automatic signals. Of the 17, 8 were rear-end, 4 were head-on and 5 were side collisions. Of the 17 collisions occurring in block signal territory there were 15 cases in which enginemen, pilots or motormen failed properly to observe or obey signal indications. These undoubtedly would have been prevented had an adequate automatic train control system been in use.

The Interstate Commerce Commission endeavors to meet in advance the arguments which of necessity will be raised against what many will term a drastic order. It will be difficult, indeed, for those interested merely in saving the investment required to answer such an argument as this, quoted from the I. C. C. report of their own order:

"Our investigations have shown that automatic train control has long since passed the experimental stage. In fact, no safety devices such as the automatic coupler, the air brake and the automatic block signal were perfected to as high a degree as the automatic train control before they were either ordered installed or were voluntarily adopted. The fourteen years of investigation and study, the service tests under varying conditions and the results obtained in the actual employment of these devices over periods of years upon some of the roads have clearly demonstrated the practicability of and the necessity for automatic train-stop and train-control."

For the benefit of the few who read this who may not be conversant with modern inventions in this field, it must be explained that the use of automatic train control devices does not remove initiative from the engineer. Under the block signal system, the stop signal is mandatory; the engineer has no choice but to obey. It has never been considered that this mandatory command to stop involves any loss of initiative on the part of the engineer.

The automatic train control makes the mandate effective even when the engineer doesn't see it. If he sees the signal, and stops, the automatic train control doesn't operate. If he doesn't see it, or seeing it, "forgets" or tries to "run by," automatic train control takes the train and stops it. The same may be said of speed control. A cautionary signal is often disobeyed; automatic train control will force the engineer to obey it. But if he obeys his signal command without delay, he will not have his train taken out of his hands.

At a street crossing the officer holds up his hand and the child on the sidewalk waits. If the child darts out in the middle of the street, the officer catches it and holds it, to prevent it being run over. Automatic train control does for the train what the traffic officer does for the unthinking pedestrian.

With this order in force, there is but one thing more to be required of railroads to insure real safety in traveling—the compulsory installation of wireless telephones, that all trains on single tracks can never again take their deadly toll, and that the engineer be in constant, not intermittent, touch with the train dispatcher.

There can be no question that this ruling of the Interstate Commerce Commission [illegible]

Flood and Drought Control on the North Platte

The Pathfinder Project That Will Straighten Out the Water Supply of Southeastern Wyoming

By S. R. Winters

[illegible] in by [illegible] Dam, built across the North Platte [illegible] Wyoming, were to [illegible] would be [illegible] to spray [illegible] to the size of [illegible] Rhode Island to [illegible] one foot. It is [illegible] largest masonry [illegible] the world. The [illegible] water-retaining walls [illegible] feet above the rock foundation; the dam is 432 feet long, 10 feet wide on top; 80 feet long and 90 feet wide on the bottom; and contains 60,210 cubic yards of masonry.

The watering plan of the North Platte project provides for the storage of flood waters in a reservoir controlled by the Pathfinder Dam, built across the North Platte River, 50 miles southwest of Casper and 109 miles northeast of Cheyenne, Wyoming. It is the second largest irrigation enterprise of the Reclamation Service of the United States Department of Interior, the Boise project in Idaho being the largest. At present, 145,000 acres of farming lands are being reclaimed to productive uses, and once the plans have been completed 252,000 acres of ground will be redeemed to agricultural production. When inventory of this irrigation enterprise was taken on June 30, 1920, the project had already entailed an expenditure of $11,868,000.

The dam and reservoir have cost—up to October 20, 1921—$1,845,000. The reservoir is a receptacle for the drainage of 12,000 square miles. It extends for 22 miles up the North Platte River and for 13 along the Sweetwater River, the artificial "pond" being located at the junction of these two rivers in central Wyoming. The area of this water-retaining tank at the level of the spillway is 22,600 acres and its capacity is 1,070,000 acre feet. The spillway exceeds 600 feet in length at an elevation of 184 feet above the stream bed. The river has an average run-off of 1,400,000 acre-feet at the Pathfinder Dam. Heavy snows in the winter and the subsequent flood waters in early spring may vary this figure considerably. The run-off during one season was 1,006,000 acre-feet in excess of the average run-off.

The Pathfinder Dam takes its name from a tradition that General John C. Fremont, popularly known as "Pathfinder," once passed through the canyon at the reservoir site on one of his exploring expeditions. This deep, narrow canyon is on the North Platte River three miles below the mouth of the Sweetwater River and 50 miles from Casper, Wyoming, the nearest railway station. The Pathfinder Dam is an arched masonry structure, the radius of the center line of the top being 150 feet. Its top is surmounted by a stone parapet, or protection wall four feet high and two feet thick on the upper face and there is a pipe railing on the lower face. The height of the top of the parapet is 5864 feet above sea level. The upstream face has a batter of [illegible] [illegible]

20 feet high; concrete wier 800 feet long; aggregate bulk of dam, 80,740 cubic yards

The Whalen diversion dam that divides the North Platte into canals on each side

ervoir is full. Not remote from the south end of the huge prison for an artificial water supply an earthen dike has been built to close a gap in the wall of the reservoir.

A curved concrete guide wall extends from the north end of the dam a distance of 108 feet along the side of the spillway to protect the toe of the dam. Also, a bridge embraces the distance from the north end of the dam to the gatehouse above the service gatehouse to that above the emergency gate shaft. Stones on the face of these massive water-retaining walls are squared and faced, being laid in regular courses with horizontal and vertical joints. On the inside of the structure are to be found oddly and irregular-formed stones, some of which weigh as much as ten tons. These rocks are planted or embedded in cement mortar, with concrete filling up the openings between the stones. Horizontal steel bars fortify the upper 27 feet of the dam to a depth of five feet from either face. Two lines of 36-inch cast-iron pipe course through the structure at elevation 5675, or five feet higher than the intake floor of the tunnel, and with floor elevation 5691 there is an opening through the dam the section of which is a square with side of four feet surmounted by a semi-circle with a radius of two feet. Stone employed in building the structure was hard coarse-grained granite, assembled from three different quarries, all located less than one-fourth of a mile from the site of the dam. The face stones, varying from two to three feet in thickness, were placed in courses with joints one to two inches thick. The backing stones—some of which weighed ten tons—averaged four tons in weight and were irregular in size. They were laid in beds of cement mortar. The vertical joints, six inches wide, were filled with concrete in much the same fashion that a farmer would daub the openings in his barn with mud.

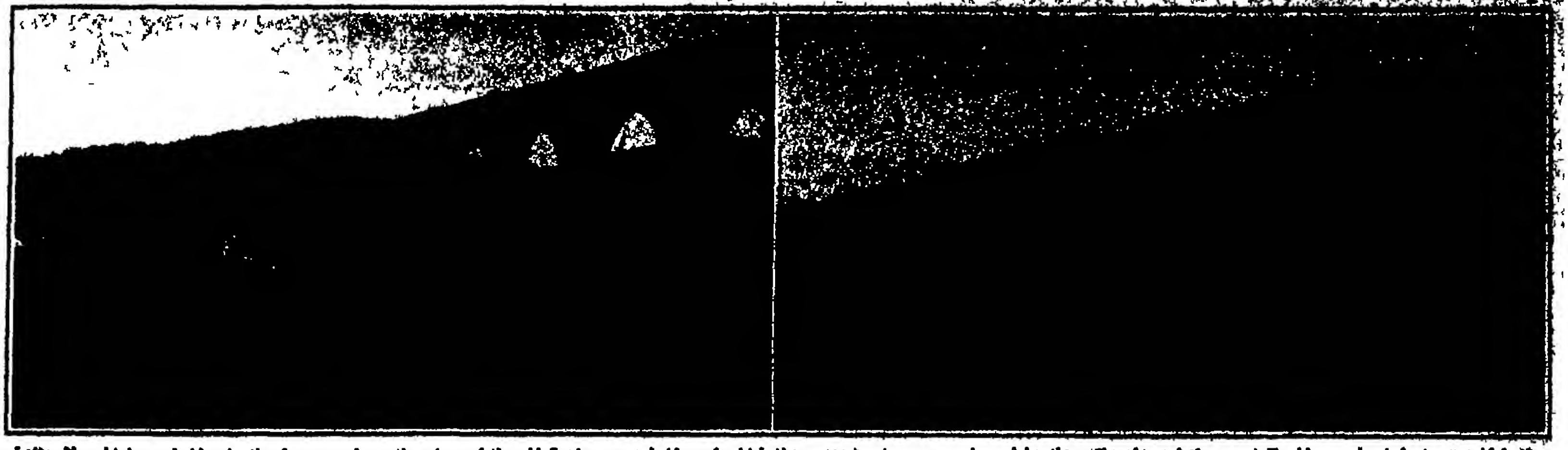
Identified with this 218-foot-high masonry dam are two tunnels, respectively 480 and 360 feet in length, through which the penned-up waters are supplied to the river for diversion at points farther down the stream. The discharge is regulated by four high-pressure gates. The latter are of gray cast iron with the contact portion of the faces covered with bronze strips in order to make easy the sliding arrangement on like bronze surfaces attached to the gate frames. Each gate is 7½ feet long, 4½ feet wide and controls a waterway 7 feet high and 3 feet 8 inches wide. The weight of the gate, including the lifting rod and piston, approximates 10,000 pounds. Immediately above each gate is a recess into which it rises on being opened. Over the shaft is a gatehouse or power unit which contains the machinery for controlling the gates. A feature of this is that, with correct use of the throttle valves in the piping, the oil pressure produced by the pump can be applied to either the top or bottom of the piston and thereby close or open the gate.

The Pathfinder dike is situated at a gap in the rim of the reservoir one-quarter of a mile south of the Pathfinder Dam. Elevation of the lowest point of the gap is 5832, or 18 feet below the elevation of the spillway of the dam. The dike is an earth embankment 1050 feet long and 20 feet wide on top, with a slope of three to one on the water face and two to one on the lower face. Its greatest height is 38 feet. Twenty-five feet upstream from the center line is a concrete core wall which reaches within 12 feet of the top of the dike or 8 feet above the crest of the spillway. The core wall is built of reinforced concrete, and at its greatest height attains 31 feet. It is 24 inches thick near the foundation and 12 inches at the top, and has a footing 18 inches thick and 5 feet wide resting in a trench 5 feet deep. The upstream portion of this embankment consists of earthy material paved with granite blocks 18 inches thick on a foundation of crushed rock 18 inches thick, and the downstream strip is made of gravelly material.

Farming on this reclamation project will involve the growing of alfalfa, oats, sugar beets potatoes, corn, wheat, barley, and beans. Such is the diversity of crops nurtured by this sandy loam soil. Dairying may be pursued to advantage and an abundance of alfalfa, sugar beet tops, pulp and waste from the sugar factory, render inviting the opportunity of feeding cattle and sheep as a profitable business. Aside from this, floods have heretofore been of periodic occurrence in this vicinity, a future safeguard will be present in this silent monarch of the stream. Damages from floods, when thus averted, may be a compensating feature equal or probably in excess of the total cost of this reclamation project.

[illegible] 218 feet high; [illegible] feet; 60,210 cubic yards of dam; cost $1,845,000

[illegible] of the big dam in the North Platte control system: the Pathfinder Dam



Left: New highway bridge in the foreground, on the piers of the old Lackawanna bridge of which the superstructure was salvaged by the railroad; and the great Tunkhannock viaduct, on which the track now crosses the valley, in the background. *Right:* Another point where the new and the old meet.

Two views of the Lackawanna Trail, at points where it touches the new line of the railroad

From Railroad to Highway

How 33 Miles of Abandoned Right-of-Way Was Converted Into a Scenic Boulevard

WHAT automobilist has not dreamt of driving over a perfect road with no sharp curves, no steep grades, no railroad crossings, no dangerous intersections and sufficient scenery to occupy the attention of the rear-seat drivers? These specifications are rarely completely fulfilled, but they will be met on the Lackawanna Trail, now nearing completion. The trail lies chiefly in northeastern Pennsylvania and will be the main highway between Scranton and Binghamton. A large part of it is new construction and the rest is improved highway in good condition.

Some 70 years ago a railroad pushed a single track from Scranton northwest toward Binghamton through rugged country, taking advantage of the valleys where possible by winding along their sides. This became the first track of the Delaware, Lackawanna & Western through this region. It proved its value and later it was double-tracked. With the advent of heavier cars and locomotives, operating difficulties because of curvature and the relatively steep grades for a railroad, led the D. L. & W. to reconstruct some 40 miles of the railroad between Scranton and the New York State line, most of it on an entirely new location. The relocation is well known among railroad men as the Tunkhannock Cutoff, features of which were the construction of two of the largest concrete bridges in the world. The new railroad location was put into operation in 1916.

The abandonment of about 33 miles of railroad road bed at a time when funds were becoming increasingly available afforded an opportunity to give this section a through highway probably unequalled for light grades and curvature in any similar terrain. For years the roads, so called by courtesy, leading north from Scranton have been the despair of the officials intrusted with their maintenance, and of the unfortunates who used them. These roads, except near the city, are steep, rough, and usually either muddy or rocky. The worst conditions were in the spring, when it was often physically impossible for anything but a light wagon to get through. The opportunity to provide a good through route was quickly seized by officials of the Pennsylvania State Highway Department who, aided by local organizations, obtained the hearty cooperation of the railroad, and for a purely nominal consideration acquired about 33 miles of the abandoned roadbed for highway purposes. This is the major part of the new route between Scranton and the New York State line where it joins an already improved section of the New York highway system leading to Binghamton.

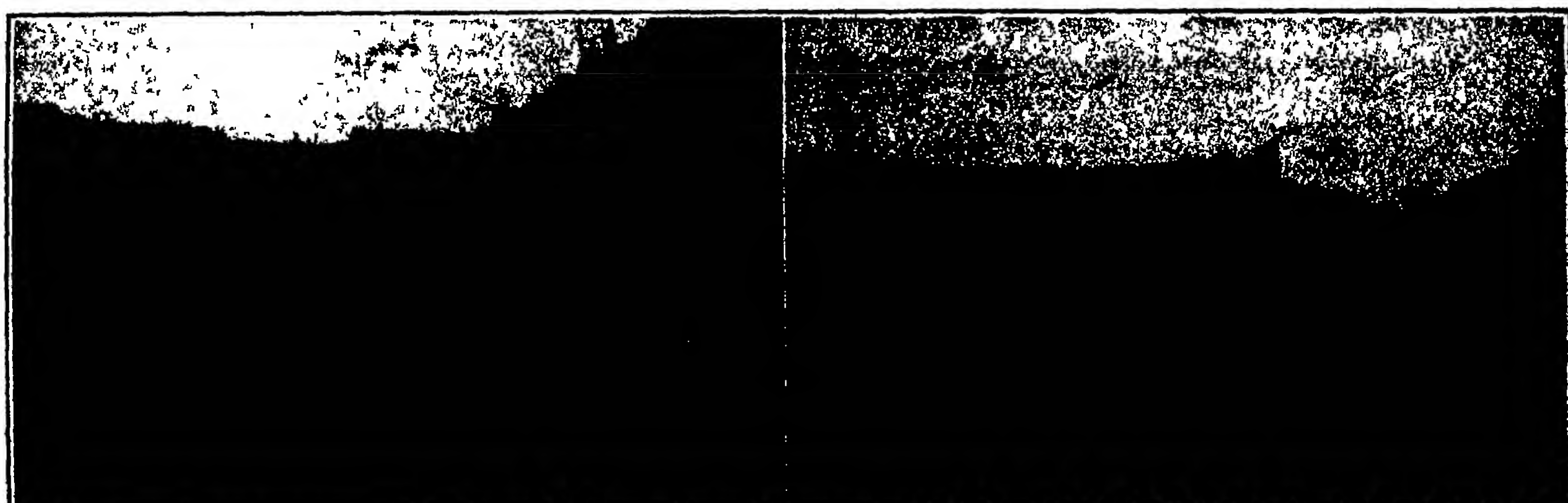
Leaving Scranton the new route follows a steep, narrow valley on existing concrete and macadam roads. At Clark's Summit it turns on to the abandoned roadbed, which it follows except in three short stretches for the next 33 miles—that is, as far as New Milford. From New Milford to Hallstead 5.7 miles of pavement is being laid on an existing highway, and from Hallstead across the New York line to Binghamton there is an existing highway, a good penetration macadam. Between Clark's Summit and Hallstead the trail is entirely new construction. Two types of modern pavement are being laid—namely sheet asphalt on a concrete base, and reinforced concrete. The new paving is 18 feet wide.

When the old roadbed had been acquired, plans were immediately prepared and contracts were awarded for the two longest sections in the summer of 1919. These totaled 23 miles of the 28 miles of new construction. The following spring two more sections were let, totaling 10 miles, and the remaining 5 miles was awarded early in 1921. All the sections are now well along toward completion.

The most difficult part of the work in many respects is the three-mile section south of New Milford. Here for about a mile it was necessary to construct a location for the highway along a steep side hill, as the railroad had not shifted its line sufficiently to permit a road to be placed on the old roadbed, nor could the highway be built beside the railroad in the railroad cut because the abrupt slope of the hill would necessitate excessive earthwork. The trail, therefore, climbs on to the hill, where it remains for about a mile before dropping back to the old roadbed. This mile is located on a natural bench, the slope of which is somewhat less than that near the foot of the hill. The quantity of earthwork involved was large. It was also difficult to handle because of the danger of blasting or spilling rock down onto the railroad.

Near Nicholson a 405-foot highway bridge has been constructed to replace the railroad bridge salvaged by the railroad when it abandoned its old roadbed. This new bridge consists of three 135-foot span deck-trusses surmounted by a concrete floor and parapets. It rests on the original bridge abutments and piers. Beside it, a few hundred yards away, the wonderful Tunkhannock Viaduct of the railroad, the largest concrete bridge in the world, dwarfs the highway bridge. Paving on the trail adjacent to this bridge had not been undertaken when our photograph was taken.

Between Factoryville and Nicholson the trail leaves the old roadbed to go around a tunnel which it was not considered advisable to convert for highway pur-



Left: Three levels on one side hill. At the extreme bottom may be dimly made out the new line of the railroad; half-way up the slope, [illegible] the new highway, is the old location of the railroad; and still higher is seen the grade on which the new roadway is carried around this hill. *Right:* [illegible] used in the construction of five miles of the new highway

Converting the old D. L. & W. right-of-way across northeastern Pennsylvania into an automobile highway of concrete and asphalt

... No construction difficulties were encountered in doing this, but, of course, it involves heavier grades than are usual on the trail. The principal difficulty encountered by the contractors in constructing the trail has been the difficulty common to all highway construction during 1920, that is, securing, handling and transporting the materials used in construction in quantities sufficient to permit production at equipment capacity. Various methods of handling and transporting materials have been used, such as haul by trucks to stock piles and from these short haul by loaders and tractors to the mixer, stock piling and handling to mixer by wheelbarrow, stock piling in small piles and transferring to mixer by belt loader, batch boxes loaded at a central material plant and handled by industrial railway to mixer; truck haulage in subdivided trucks from central plant to mixer. As the methods were used under varying conditions of haul, grade and efficiency of superintendence, generalization as to the relative value of these methods is subject to criticism. It may be stated, however, that for short hauls, particularly, the industrial system was successful. Especially where it was possible to make some of the haul on the completed base or pavement, trucks were less expensive for the longer hauls, some of which were as long as seven miles. Stock piling on the sub-grade near the mixer is no longer permitted by the Pennsylvania State Highway Department, but the old contracts which were in force when this ruling was made may still use them. A combination of small stock piles of stone handled by loader and tractor for a hundred or so feet of haul to the mixer combined with sand hauling by shovel from small stock piles into wheelbarrows, proved very effective. The elimination of stone shoveling was a boon to the workmen and seemed to speed up the paving operation where it dragged the most.

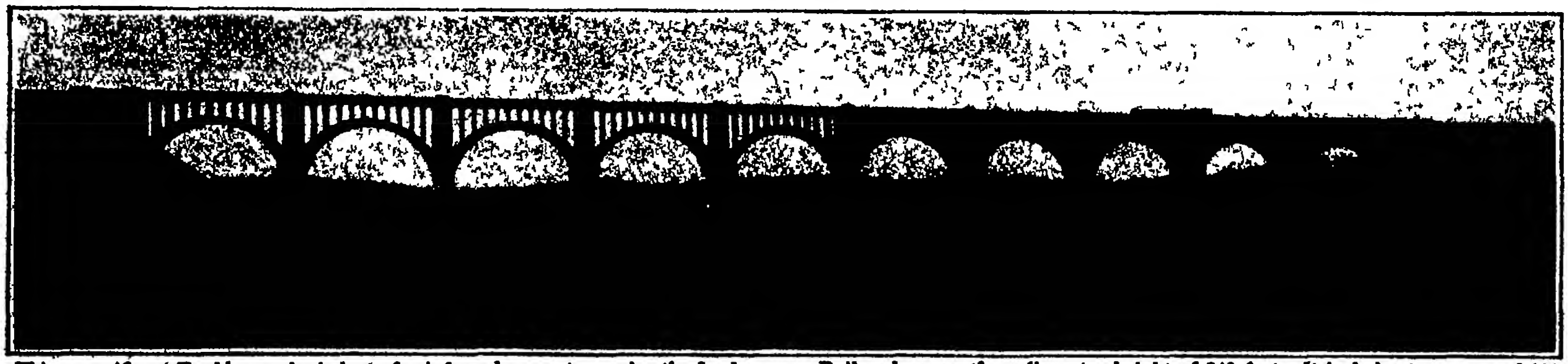
One of our figures shows the forms, mixer, industrial railway and cars as used on about five miles of the trail. The track on the right was of 36-inch gage over which steam locomotives hauled bin cars of materials. This line was the feeder for two paving plants. The bin cars were placed on switches about 1000 feet from the mixers and the materials drawn by gravity into batch boxes on cars of the 24-inch industrial track shown on the left. These cars were pushed by gasoline locomotives to the mixer. The batch boxes were swung over the mixer dropper by a crane attached to the mixer. A section of base, ready for the asphalt surfacing, is shown in the second view at the top of page 316.

The completion of the trail early next year will open a section of northeastern Pennsylvania which has hitherto been inaccessible to all but the most venturesome of tourists, and will complete a link in what will undoubtedly become a famous tour from New York through the Delaware Water Gap to Scranton, and by the trail to Binghamton, from which point there is a wide choice of good roads east, west, and north over the New York State system. The route from the Water Gap to Binghamton will be one of the most scenic in the east, and, what is of equal interest to the motorist, it will be one of the best surfaced. For the information on which this article is based we are indebted to Col. W. D. Uhler, Chief Engineer of the Pennsylvania State Highway Department.

It looks a bit dangerous, to say the least—but fewer accidents occurred here than on the straighter road pictured below

The Motion of the Perihelion of Mercury

THIS question is now of special interest owing to the close agreement between the value of 43" per century given by Newcomb and the value of 42.89" deduced from Einstein's theory. Newcomb estimated the probable error of his determination as 2" per century, but an article by E. Grossmann in *Astr. Nach.*, No. 5115, which comes to us through the columns of *Nature*, re-examines the observational evidence, reaching the conclusion that the actual range of uncertainty is much greater. Newcomb based his result partly on meridian observations and partly on transits across the sun. The difficulties in observations of the latter phenomena are well known, consisting partly in the "Black Drop," and partly in the unsteady image which the sun's heat often produces. There is the further fact that the transits all take place at two particular points in the orbit and consequently are incapable of determining the motion of the perihelion by themselves; they merely lead to an equation between different secular motions. The meridian observations are also not very satisfactory. They lead in the mean to a distance of Mercury from the sun greater than that corresponding with its period of revolution. Moreover, Herr Grossmann shows that the observations before and after 1850 (about the time when chronographic observation began) have large systematic differences. He finally obtains 29" and 38" as the limiting values of the secular motion indicated by the observations. A recent series of observations made with the traveling wire micrometer of the Cape Transit Circle gave a value very close to that of Newcomb.



This magnificent Tunkhannock viaduct of reinforced concrete carries the Lackawanna Railroad across the valley at a height of 240 feet. It includes ten spans of 180 feet; two of 100 feet, and is 2375 feet in total length

Where Road Wrecks Happen

AUTOMOBILE accidents occur more frequently on highways free of curves, steep grades, and railway crossings than on roads where natural danger signals are obvious, if we are to accept with a degree of finality a survey recently made by the Maryland State Roads Commission. The conclusion is that reckless drivers are more cautious in the presence of glaring dangers while on a highway where evident dangers are absent to take a gambling chance with life is a seemingly inviting allurement.

Maryland is perhaps the first State to introduce a system of searching inquiry into the cause for each and every automobile accident within its boundary limits. Daily reports from patrolmen to the chief engineer of the highway system describe any mishap, indicating the exact spot and nature of the accident. The reports afford information as to the character and reason for the accident, whether or not the result was fatal, number of persons injured and killed, and the license numbers of the vehicles involved. Well-defined blanks are provided each patrolman for writing down such information. The reverse side of the blank contains four diagrams of typical stretches of highway. The sections thus represented include a length of tangent, a single curve, a reverse curve, and a cross-roads intersection. The patrolman is thereby enabled to indicate the location of the mishap and tell the distance of the point from the nearest town.

Three months' records, during which time 94 accidents occurred involving loss of life in 14 instances, serve as a basis for placing responsibility for the cheapening of human life. Speeding is the factor held accountable for 90 per cent of the disasters visited upon motorists. Differently expressed their own recklessness is responsible for their undoing. And here may be supplied text explaining the significance of the photographs illustrating this article. The road, level as a marble floor and straight as an arrow, free of sinister curves, is a stretch of highway on the National Pike between Baltimore and Frederick, 48 miles of the straightest road in Maryland. Speeding obviously has been undertaken with reckless abandon. Sixteen accidents, three of which exacted a toll of life, have occurred within three months. The companion illustration shows a type of road commonly identified with the word danger. Sharp curves, grades, and railway crossings are its recognized tokens conducive to disaster.

The Maryland record explodes this popular theory. In the western half of the State, where the inclines are naturally steep and the gradings curve abruptly, only eight accidents have happened in three months. There was not a single fatality. And we find that the railway grade crossing in Maryland too frequently the menace to motorists in other States, has not proved to be the outstanding cause of fatalities. A summary of accidents occurring on the State highways of Maryland from May to June, inclusive, is thus represented. Violation of motor law, 60, 10 fatal; wet road, 20, 4 fatal; car trouble, 14, none fatal. The 14 ill-fated accidents are classified as follows: Failure to heed warning at railway crossing, 2; speeding, 4; driving on wrong side of road, 4; reckless driving, 4. Most of these items reduce to "speeding."

Though it almost appears that human ingenuity could hardly devise a way to wreck a car on this straight, wide-open Maryland highway, the records show that more accidents happen here than on stretches of road that proclaim their dangers with sharp turns and other obvious hazards

The New World

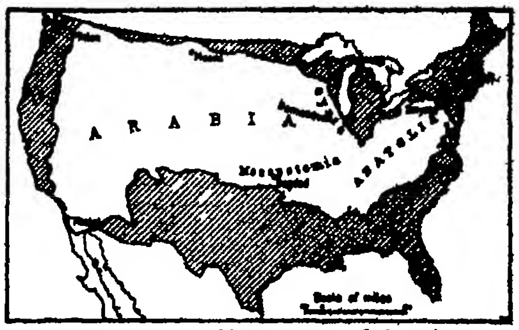
A Review of Dr. Bowman's Book on World Reconstruction

By Albert A. Hopkins

GEOGRAPHY is or rather was up to the time of the war a somewhat neglected subject True, we had excellent geographical societies geographical reviews and books on every phase of the subject, still the popular imagination was not stirred at all and it took the World War to break down the barrier and make the noble science of geography tie into everyday life The war stopped not as suddenly as it began perhaps but quickly enough to stir us to the depths To us in the United States we felt a relief that the carnage was ended and that the pouring out of treasure was almost at an end but we did not realize that war brings in its train evils which are hardly less acute than actual war fare barring of course loss of life and limb Our whole system of education unfitted us for the task of helping to reconstruct a bleeding and unfortunate world Our century long and uninterrupted success in territorial expansion (*for our house is of very thin glass*) the high and false values set upon material wealth together with our political affiliations increased the difficulties of a time beset by perils of a new order We had been living behind brick walls in a kind of enchanted garden a garden which watered itself a weedless garden and a garden into which rubbish was seldom if ever thrown Suddenly after the collapse we found that our brick wall had disappeared over night and that our garden had no protection In America we have never had a trained and permanent foreign office staff and however lofty our intentions we work so far as scholarship goes on administrative principles little different from those of a hundred years ago Our ignorance of foreign countries was unbounded although the newspapers had done their bit in helping to show certain aspects of political geography as well as battle areas There was one place however where the mid night oil burned always even in its more prosaic form this was the American Geographical Society in New York where the great collection of maps and books was under constant guard of soldiers police and detectives for no chances were taken with this material which was to lend itself to such good uses.

One day after the armistice when all eyes were directed to Paris three army trucks drove up to the building on upper Broadway and took away 5000 books and untold maps to the waiting steamer This material might have been valuable in itself but it needed one who could unlock the key to the riches, and this was furnished by Dr Isaiah Bowman the Director of the American Geographical Society who spent many months in Paris as special geographical expert to our government with the title of "Chief Territorial Adviser," during the long period of negotiations. After Dr Bowman returned he decided to put on record not only in the form of words but in the form of maps an imperishable record of what the war really meant to the world for there is not a man woman or child in any civilized country and in some uncivilized ones as well who is not affected to a greater or less degree by the war To provide the *background of information* which the average citizen needs to understand the main international questions of our time has been the aim of Dr Bowman in "The New World" which is issued by the World Book Company in sumptuous form The author has given this book as a contribution to geographical knowledge without material advantage to him as all the beautiful maps could not have been supplied by any publisher without the author's generous cooperation and so we must look up to Dr Bowman as a real benefactor to geographical science

The major problems of the new world are many and complex and are not likely to be settled in our time The qualities of selfish ambition and envy are deep seated they will pass away only when human life itself is extinguished So long as they exist there will be war with its subsequent effects upon political social and economic life Almost every event of our time has its counterpart in history Each age has had its grand catastrophe its great war and we are now the victims of the greatest of them all Like the vast geologic eras of earth history, the new age dates from a period of general change in habit of life. Our political and social environment has been revolutionized. We now look out upon world problems and alien peoples, almost unknown to us until yesterday, in a spirit akin to that of Europeans four centuries ago, when they stood at the threshold of the Age of Discovery Some of the new world problems are as follows Can the new world be set going in an orderly manner how much of the old world

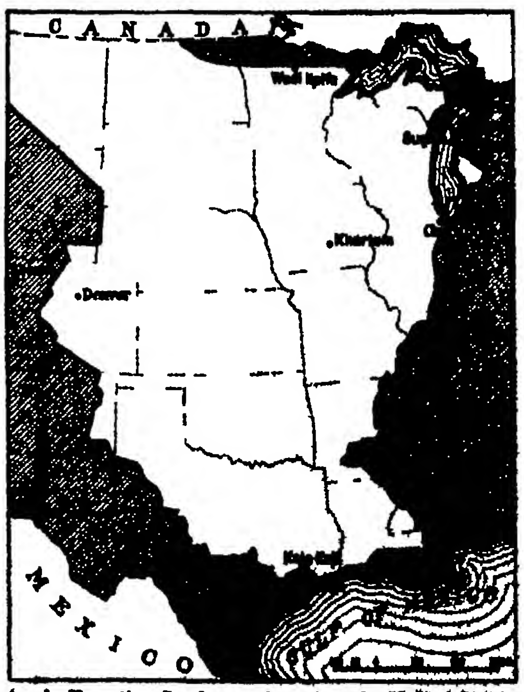


Anatolia and Arabia in terms of American locations

is left what new boundaries concessions, colonies, mandatories spheres of influence and protectorates now appear on the map of the world what kind of people compose the new states will the democracies survive—

Why Japan wants room A typical Japanese village with farms on every hillside

Poland Jugo Slavia and Austria for example what elements of economic strength and weakness has each of the new states, and also each of the old states whose resources have been either increased or dimin



Anglo-Egyptian Soudan projected on the United States, 250 miles of railway in this territory

ished by treaty; how will the [illegible] states meet their new rights and [illegible] the grip of the powers in [illegible] regions (this means us also) [illegible] lessened without anarchy following; can [illegible] armaments be reduced, has the day of [illegible] come for the oppressed minorities of the [illegible] far can the protection of minorities be [illegible] strong nations continue the struggle for the [illegible] liages, raw materials, and strategic [illegible] the prospect of war between them if they cannot [illegible] their commercial and political ambitions otherwise? In short, will the changes in the political and economic geography of the world spell peace or war, strength or weakness, in the years immediately before us? These are vital problems for every nation By reason of some of them war may come, not in a generation, but in a few years. The danger spots of the world have been greatly increased in number the zones of friction lengthened. Hatred has been intensified by the cruelties of war, an orderly world has been turned into a disorderly one and we are trying to put the pieces together and they do not all fit Dr Bowman has given us the dissected pieces and we can, with the aid of his maps make a fairly good semblance of what it should look like in a short period of time. This is a subject and this is a book which should interest everyone for no American, however secluded his life, however distant his home from the big cities and the coasts, is free from the consequences of the World War The world is broken its international life is disrupted; it is in a state of general economic disorder

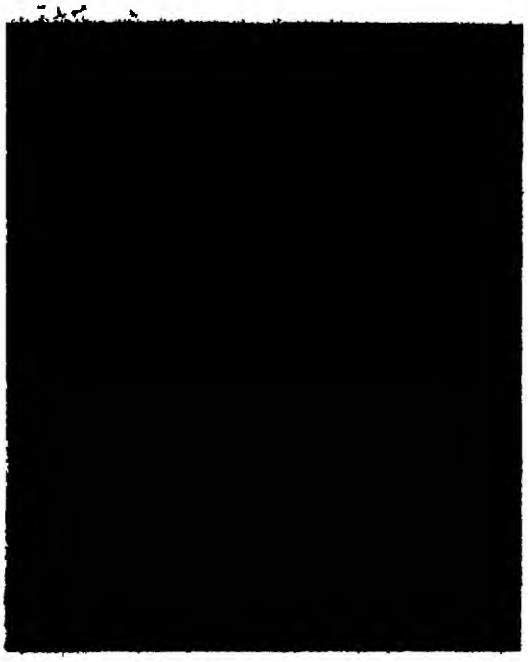
The foregoing remarks really give an idea of the book which develops theme after theme with a rare insight into the subject both from an economic, an ethnographic and a geographical point of view There are 260 maps and illustrations, mostly maps, which are beautifully executed from the best sources, rendering them very authentic It is really a geography or atlas like none other in the world, and as an example we give two of them. We hear very often of the Anglo-Egyptian Sudan as if it were something like Rhode Island, Long Island or Block Island. Now here it is projected on the United States Is it any wonder that there are immense difficulties in managing such a vast territory in the heart of Africa with only 250 miles of railway At Paris they wanted us to "have" the Mandate of Armenia Fortunately we had the good sense to refuse. Look on the map of Arabia and see what a mandate over this kind of country would have meant All our other troubles the Philippines turbulent little Porto Rico Santo Domingo Nicaragua, Panama would be as nought compared with this enormous stretch of seething territory in the midst of which troubled Armenia is found. We are apt to sit down and very virtuously talk about the aggression of England, the imperialistic tendencies of France, Fiume and Italy Here are the facts since 1898 the United States has extended its influence and control more rapidly than any other great power even imperial Russia amounting to 251,044 square miles and 17 598,750 population—all this in nineteen years. The tendency to expansion is very marked yet we cry out with true Pecksniffian fervor if Japan wants her children's rice bowl filled, and, by the bye, here is a picture from the book showing a Japanese village, and how every inch of ground is utilized to grow something The whole book preaches a sermon against selfishness, not of the individual but of the nations. We have a long and a hard journey to travel, and this book shows some of the pitfalls and some of the milestones of progress, which we must pass if we wish to reach the summit of the mountain from which we can view the "New World."

Percentage of Home Ownership in Cities of the United States

BASED on the figures of the [illegible] Bureau of Statistics of the Department [illegible] merce has completed a chart showing [illegible] percentage of home ownership in [illegible] United States having a population of over [illegible] addition to the chart, tables are [illegible] the corresponding percentages [illegible] [illegible] in the country was in New York [illegible] 1,278,341 homes, of which but 12.7 [illegible] by the occupants. At the other [illegible] Moline, Iowa, with 22,644 [illegible]

The Submarine Artist

Waterproof Paints and Canvas and a Diver's Suit Applied to a New Phase of Art



Painted in their native element: Queer fishes of the South Seas—from an oil sketch done under water off Tahiti

ONE of the most curious manifestations of artistic talent has been recently accomplished abroad by a landscape painter Mr Zarh Pritchard It is impossible for us to term the product 'landscapes' or even "seascapes" which is a well known term for seashore pictures. Perhaps we can find an expression which outlines Mr Pritchard's technique for he paints literally at the bottom of the sea if the sea is not too deep He is only limited by the depth which a diver can descend. Perhaps the word "undersea landscapist" would fill the bill. The ordinary methods and materials must be thrown in the discard when this extraordinary artistic procedure is considered We are indebted to our excellent contemporary *The Illustrated London News* for the pictures presented and for the idea of the cover which is worked up from a copyrighted drawing made especially by W R S Stott for the beautiful English periodical named above Our Mr Howard V Brown has caught the spirit of Mr Stott's monochrome and has translated it into a blaze of color on our cover

This new idea is one which will not probably be popular with our art students, as few indeed would have the endurance or the means to try such a unique avenue of expression Mr Pritchard works at depths ranging from 16 to 50 feet He is clad in the most approved diving costume with the usual lead loaded shoes to keep him on the bottom and the usual signal ropes and air hose He descends slowly through the water as we have all seen in the movies, and after carefully exploring the territory near where he lands he selects a comfortable rock not looking for a dry one as he would probably do on land He then pulls the rope and down come the easel and the box of colors Of course the colors are specially prepared and ground extra thick in a special way and the canvas is also waterproofed or otherwise treated with linseed oil so that the water will have no effect on it Then he blocks in his outlines and proceeds to lay his tints and finish the whole roughly

It must not be supposed that an ordinary seashore resort would lend itself to this means of painting In fact there are only certain places where it would be of any avail Bermuda Tahiti the Saragossa Sea and many parts of the Mediterranean and almost any coral strand would furnish the raw material These pictures are regarded as so important that an exhibition was recently held at the Galeries George Petit in Paris Several of them were purchased by the Prince of Monaco who is an oceanographic expert of the first magnitude

Mr Pritchard has always been fond of diving and in his youth his favorite pastime was diving In the bay of Portobello in Scotland he would remain under water weighted down by a bag of sand It was then that his eyes were opened to the fairy wonders of the ocean floor But it was in Tahiti that he first donned a diver's costume and made his first descent to a distance of 65 feet He was obliged to rise to the surface after about a half hour owing to cold or fatigue from the pressure of the water He often left his painters materials at the bottom and we dare say many a fish has had indigestion from such colors as emerald green Sometimes he even left them overnight as there are no currents among the coral reefs

For the benefit of our newspaper friends we may state that the copyright in these weird productions is strictly reserved by the artist who has kindly allowed us permission to use them through our excellent English contemporary referred to above.

[illegible] at a depth of 22 feet [illegible] a beach cliff off the South Seas

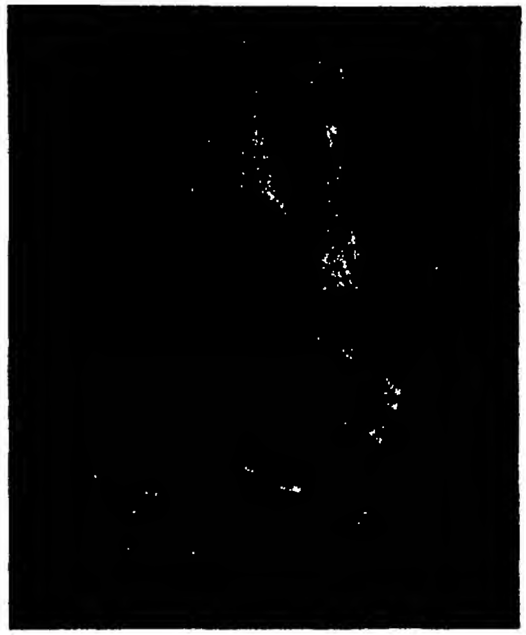
Moth-Proof Wool

WITH all of the many virtues of woolen fabrics for the making of garments they have one annoying quality in that they present a tempting titbit for one of the worst insect pests which afflict mankind—namely the ordinary clothes moth which finds nothing edible in cotton linen or silk but dotes on wool The announcement made a few months ago by a German firm that they had perfected a treatment for woolen fabrics making them absolutely moth proof is of the highest importance since it presents an opportunity for the prevention of what are at present enormous losses from this cause

The treatment is extremely simple, since all that is needed is to place the woolen goods in a cold solution of the new chemical until thoroughly saturated. It is then taken out of the solution hung up for a few hours, carefully rinsed with fresh water and dried

Woolen goods thus treated are absolutely unappetizing to the greediest moth larva This was conclusively proved by various experiments Photographs of two pieces of flannel exposed to moths, one of which was untreated while the other had been dipped in Eulan F showed that the former was riddled with holes while the latter was untouched Again a few strands of wool were placed in two test tubes within which moth eggs were then placed. Six months later photographs showed that tube A, containing the untreated wool, was quite empty except for the excrement and pupa cases of the larvæ, while tube B contained the woolen contents intact plus the corpses of the larvæ, which had quickly starved to death upon issuing from the eggs.

The circumstances which led to this valuable discovery are unusually instructive, showing as they do that an alert mind is stimulated by a mere suggestion which would bear no fruit if it fell upon less fertile soil. Dr. Ernst Meckbach, writing in *Die Umschau* (Frankfurt) concerning this discovery, which appears to be due chiefly to his own researches, tells us that he was instigated to the latter through the circumstance that he frequently heard housewives ripe in years remark sagely Moths won't touch green cloth This struck him as so curious that he began to experiment with the result that the moths ate the green stuff as eagerly as that of any other color It occurred to him however that the green dyes of modern use might be different in character from those used in earlier days Investigation proved this theory to be correct It was found that green cloth dyed some 50 years ago actually is moth proof Strange to say however it is not the green dye which is distasteful to the insects but a certain yellow dye—the well known Martius yellow one of the first of the artificial dyes made from coal tar The reason for the use of this is that nearly all green dyes are blue-green so that yellow dye is commonly added to them to alter the shade It was the Martius yellow thus employed which rendered the fabric safe from the attack of moths



From a painting made at a depth of 50 feet in the South Seas Coral towers at the bottom of the sea off Maraa, Tahiti

Painted rocks at the bottom of the sea: A submarine "landscape" from a study in oils painted 16 feet under water

Transmitting Power in Fluid Waves

Further Details About a System Already Mentioned in a War-Time Connection

From Our British Correspondence

WATER is popularly termed incompressible and we have no doubt that many of our readers accept this statement literally and absolutely. It is true enough that water is compressible with difficulty that beside other fluids it is relatively incompressible. But the idea that it is not to be in any smallest degree compressed calls for a state of mind similar to that of the Greeks who talked learnedly and disputatiously about irresistible forces and immovable obstacles.

Suppose we have 150 meters of ordinary wrought iron piping of 2.5-centimeter diameter and ¼ centimeter wall thickness. Suppose we force a fluid tight piston into this pipe under a pressure of 35 kilometers per square centimeter. If we imagine the water to be absolutely unaffected by this pressure the walls would expand sufficiently to permit the piston to enter 15 centimeters. If we imagine the walls to be absolutely inexpansible under this pressure however the compressibility of water is such that the piston will enter 28 centimeters. Negligible as it is in ordinary hydraulic practice this compressibility of water is sufficient to lead to hope for a useful application.

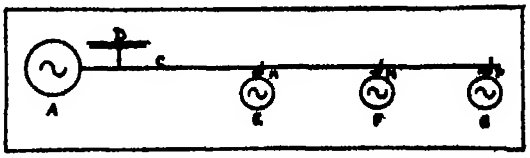
In 1917 rumors reached this country of a new system of power transmission by compression waves in columns of water. Not however until our issue of May 17th 1919, was it possible for us to present anything approaching a satisfactory account of the so-called CC gear for shooting a machine gun between the blades of the revolving airplane propeller. A more coherent general statement of the new transmission scheme appeared in the SCIENTIFIC AMERICAN MONTHLY for December 1920. Only now is it possible to discuss the system in full detail.

Wave transmission was first visualized by George Constantinesco in 1914. Mathematically it is simple and effective practically many difficulties and prejudices have had to be overcome. The procedure consists in the setting up of wave motions or pulsations in an enclosed column of liquid usually water which is contained in a pipe connecting the wave-generating apparatus with the point of power application. Where ordinary hydraulic transmission depends upon the degree of incompressibility possessed by water the wave system utilizes the very fact that water can be slightly compressed and only slightly. The generator sets up pressure impulses in the column of fluid. There is no continuous flow the liquid particles merely oscillate back and forth between two extreme positions. A wave of pressure traverses the tube and gives up at the far end the energy that put it into being.

Consider a column of liquid of considerable length enclosed in a tube. Let us imagine it under a moderate steady pressure. In addition let us suppose that rapid blows, 40 or so per second are being delivered against one end of the column. The only resistance to these blows is the inertia of the fluid and if the column be short it will act as a solid mass. If it be of considerable length however the motion of those layers of the fluid near the impelling piston will be resisted by the inertia of the more remote layers. Compression will result and there will be a point in the liquid column at which on the completion of the instroke of the piston no movement of the liquid will have occurred. Without going into further details it will be seen that we have here a condition that determines the wave-length of the disturbance that is propagated through the fluid—or better its half wave length. The wave length will actually be the quotient of the wave velocity in the medium by the period of the piston. The velocity is found to be substantially that of sound—in water 4800 feet per second. Experiment and commercial development have employed for the most part a period of 40 cycles. This means a wave length of 120 feet. The wave is a simple and symmetric one represented by an ordinary sine-curve.

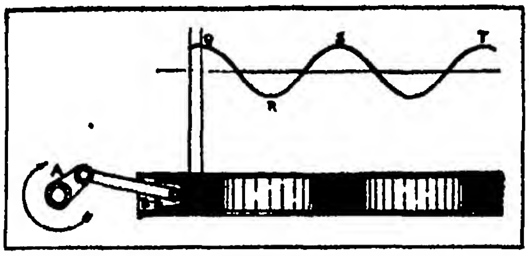
Suppose the pipe is an exact multiple of the wave-length and is closed at the far end. When the compression wave reaches this point it will be at a crest and reflection will bring it back to meet the following waves crest to crest and trough to trough. It will continue back to the starting point in this way with the result that a compression wave of double the original force traverses the pipe. This piling up will go on without limit until the pipe is ruptured by a force greater than its tensile limit.

We must not then have the far end of the pipe closed. Indeed in any event we should want there a floating piston to take up and convert into work the energy of the waves. But when this piston is not doing work which enables it to take up all this energy, the conditions leading to ultimate rupture are again present. Means must be provided to prevent this before we have a practical system.



Diagrammatic scheme showing arrangement of wave-generator and meters

This means is simple enough. A receiver of generous size, compared with the displacement of the driving piston opens off the line at a point near this piston. Initially it is full of the fluid. At each instroke a flow will take place into the receiver and its contents will be compressed at each outstroke the compression will be relieved. The receiver will thus act as a spring, taking up the energy of the direct and reflected waves when the pressure is high giving it back when it is low. The mean pressure in line and receiver will however be the same so when reflection of waves through



Two more or less conventional representations, by means of compression areas and the sine curve, of the pressure wave that travels through the pipe

the pipe has produced an amplitude corresponding to this mean pressure the piston will merely exert energy in compressing the liquid in the receiver on its instroke and the receiver will restore this energy to the fluid on the return stroke. So when the reflected waves have been built up to the proper pressure further building up will cease and there will be a series of stationary waves in the pipe. There is close analogy here to an electric generator running light.

We have here the elements of successful commercial operation. A is the generator. D the receiver or capacity. E, F and G motors at distances from A of one-half, three-quarters, and a whole wave-length. If the cocks M, N and P are all closed, no energy is absorbed, because of the capacity D. If P be opened, G will absorb some or all of the energy given off by A. A traveling wave will traverse the line. Only when P is closed and another cock is opened will there be any stationary wave in the pipe—from E or F to G. Since it is only with a stationary wave that there occur nodes or points of zero pressure-variation, motors may be connected effectively at any point of the line, not merely at exact quarter wave-lengths.

It is plain that wave transmission bears a distinct resemblance to alternating current, in fact, directly equivalent terms exist in the two systems—period, phase capacity, amplitude (current) and pressure (voltage). Internal resistance to vibration of the liquid is equivalent to electric resistance. Sympathetic communication of wave energy through the pipe walls occurs and is akin to resonance. If a large mass of heavy material be inserted in the line we have a reactance which will set up inductance or lag. A "capacity" sets up a lead and opposes this reactance. A transformer would consist of two pistons of different diameter connected by fluid. And we might pursue the analogy further.

The generator now on the market consists of two plungers actuated by a revolving crank. Each downstroke compresses the water in the system about one-half per cent by means of a plunger displacement of about 20 millimeters. The momentary pressure of the simple unreinforced wave is 1600 pounds per square inch. The actual pressure at the summit is 1700 pounds and at the trough 100 pounds the latter pressure being maintained in the system by auxiliary pump. This minimum pressure eliminates air troubles, since it is quite essential that the system be free of air. Each plunger has its own cylinder and its own "capacity."

The generator is so free from vibration that when at work a coin may be balanced edgewise on it. Belt driving is permissible but direct coupled drive without intermediate gearing is preferable when a power unit of appropriate speed is available. It is necessary to have governing within about 5 per cent when the transmission line is up to 300 feet when it is longer, the generator speed should be more constant than this. Two or more generators can be run in parallel, supplying power to a single pipe line.

The simplest application is to rock drills and rivetting hammers where the piston is used as a floating hammer and strikes directly on the shank end of the drill or rivet snap. The efficiency of a wave-transmission drill is as high as 50 per cent whereas a compressed-air plant for mining work will show but 10 per cent. In addition to the direct saving in power thus effected, the wave-power plant is simpler takes less space, and is altogether more economical than the compressed-air one. A noteworthy point about the wave-power drill is that it is rotated every blow even though these take place at the rate of 40 per second. This is accomplished by a subsidiary motor actuated by wave-power and in absolute synchronism with the percussive motion. Compressed-air drills have not this action nor can they be cooled by a water supply at high pressure on the drill point unless additional apparatus be attached.

When a rotary motion is required a three-phase gear is generally used, both generator and motor having three cranks set at 120 degrees. A wide range of flexibility obtains here, however.

Difficulty was experienced by the pioneers of this system in designing suitable transmission piping. For straight runs ordinary hydraulic piping does nicely, but for flexible piping new invention was necessary. The result is highly ingenious, consisting of short lengths of straight metal tubing united by a spherical joint. This is a piece of metal, usually steel, with a spherical shape at each end. In this fit the straight lengths of solid tubing, by means of a ball and spherical packing. A spherical nut screwed into the double socket completes the arrangement. The pipe will stand the

(Continued on page 337)

Wave generator, showing "capacities," self-adjusting variable-feed pumps to maintain the minimum pressure, the flexible pipe-line, etc.

America's Debt to the Howe Truss Timber Railway Bridge

FEW people, if any, outside of the engineering profession appreciate the debt which we in America owe to a certain highly efficient type of wooden bridge which was used most extensively in early railroad building in the United States.

We refer to the Howe truss timber bridge and its first cousin, the lofty timber trestle, without which it would have been quite impossible so quickly to connect the Far West and the Pacific coast by means of the pioneer railroads of the middle of the nineteenth century. Had the United States not been so abundantly supplied with forests of excellent constructive timber, and had it therefore been necessary to bridge the rivers and canyons of the west with steel structures, the progress of our transcontinental roads would have been greatly delayed and their cost in some cases raised to impossible figures.

The Howe truss bridge, as will be seen from the accompanying photograph of a timber bridge over the McKenzie River on the Southern Pacific system, is a very simple structure containing a minimum amount of iron or steel. The top and bottom chords, which are parallel, consist each of four sawn but undressed timbers, assembled on edge and spaced a couple of inches apart with separating blocks of wood between, and securely bolted together to form a compact whole.

The diagonal members consist of square, or approximately square, timbers, assembled in pairs and bolted together at their centers; and the vertical web members consist of a series of threaded round iron bars, extending the whole depth of the truss and secured by nuts on the top and bottom faces of the chords. The end of each diagonal member is cut square or normal to its axis, and these ends bed against triangular cast-iron blocks, whose faces have been formed at the correct angle to provide a fair footing for the ends of the diagonals. The longitudinal component of the thrust of the diagonal members is transmitted from them to the chords by means of continuous, transverse and vertical lugs and logs of square section, which are let into the inner faces of the chords. Two complete systems of wind bracing run from end to end of the bridge, one for the top chord and another for the bottom chord. There is also a system of sway-bracing, introduced between the diagonal members throughout the bridge.

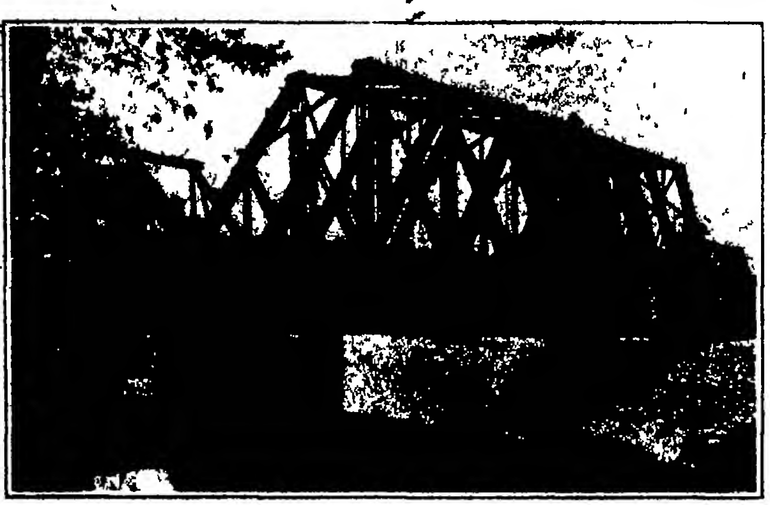
The excellence of the Howe truss for pioneer railroad building consisted in the two facts that it called for a minimum amount of iron and that the whole of the timber could often be found in the pine or fir forests through which the railroad was being built. A bill for the round iron rods was sent to the eastern steel mills, and then a portable sawmill and a gang of bridge carpenters did the rest. These bridges were simple, easy to frame and rapid in construction and erection. Once put up, their term of life was limited only by the care with which they were inspected and decayed timbers replaced.

The majority of these remarkable bridges were probably from 75 to 125 feet in length, but where necessity called for it, the bridge engineer of those days did not hesitate to build in lengths of 175 to 200, and even, as in the case of the Southern Pacific bridge here shown, 250 feet. Evidence of this may be seen in the accompanying list of long-span Howe truss bridges, which at one time or another were in service on the Pacific system of the Southern Pacific Company.

Colorado River, at Yuma	195 feet
Kings River, at Reedley	192 "
Los Angeles River, at Los Angeles	202 "
[illegible] River, at Sespe	192 "
Salinas River	192 "
Alameda Creek	198 "
American River	191 "
[illegible] River—1st Crossing	204 "
[illegible] River—4th Crossing	204 "
Willamette River, at Harrisburg, two spans of	200 "
[illegible] River, at Coburg	250 "

For these particulars we are indebted to Mr. W. H. Kirkbride, Engineer of Maintenance of Way and Structures of that company. These spans have now been taken down, but the company still has three bridges of 200-foot length in service.

A remarkable fact about the Howe truss bridge was its ability to hold up in the face of long neglect. If so neglected they would sag, but rarely did they break down. In fact, the present writer, during many years of service on western railroads, failed to meet with any case of total collapse. To anticipate and counteract the sagging, a new span was always built with a slight upward curve or camber.



A 250-foot wooden railroad span over the McKenzie River. This type of timber bridge made early Western railroads possible

Facts Concerning Molybdenum

THE United States possesses the largest known deposits of molybdenum ores, but is relatively poor in high grade deposits of some other important alloying elements used in alloy structural steels, such as automobile steels, says the Federal Bureau of Mines. Nickel, chromium and vanadium are the standbys in present-day alloy steels. Of these we have very little nickel, some chromium, mostly in relatively low grade ores, and only small deposits of vanadium. It is of utmost importance to know to what extent molybdenum can replace any of these elements. Moreover there is as yet comparatively little market for molybdenum.

According to tests made by H. G. Chandler and C. H. Willis, given wide publicity by producers of molybdenum, that element as an alloying material ranks with nickel, chromium and vanadium in preparing steel of high quality. Molybdenum steels found some use during the war, but their production thereafter almost ceased.

In order to corroborate the published tests, to extend them, and to study in detail the shock and fatigue-resisting properties of molybdenum steels, a cooperative agreement was entered into by the Bureau of Mines with the Vanadium Corporation of America, producers of molybdenum, by which the services of R. J. Thompson, metallographist, were made available. The cooperation of the Wyman Gordon Co., Worcester, Mass., was enlisted in making impact and repeated impact tests.

A comprehensive series of molybdenum steels, and of other steels for comparison, has been made in the electric-furnace laboratory of the department of chemistry at Cornell University, and rolled at the Halcomb Steel Co. plant, and test bars were machined, heat treated and given tensile and fatigue tests in the shops and laboratories of the Sibley School of Mechanical Engineering at Cornell University.

These investigations are well under way, though much of the fatigue-testing work remains to be done. Since it was begun a good deal of information all favorable to molybdenum steel has been published by steel makers, but very little has been published on impact tests and nothing on fatigue tests. This work should add materially to the knowledge of the properties of these steels.

Cerium compounds are a by-product of the gas-mantle industry. They find limited use as an ingredient in the cores of flaming-arc carbons and, reduced to metallic forms, in the pyrophoric alloys used in cigar lighters. In order to study the effect of cerium on steel and non-ferrous alloys a cooperative agreement has been made by the Bureau of Mines with the Welsbach Co. The work on cerium steels has been carried along with that on molybdenum steels and in a similar manner. It has been established that cerium can exert a desulfurizing action. There are, however, some difficulties in the preparation of these steels and no final conclusions can yet be drawn as to their value.

In the work on special alloy steels conducted at the Ithaca, N. Y., office of the Bureau of Mines, situated at Cornell University, under the direction of H. W. Gillett, chief alloy chemist, the cooperative work with the Navy has been completed and considerable progress made in the investigations on molybdenum and cerium steels.

In the past fiscal year the work done on the preparation of zirconium and other steels for the Navy was mainly analytical and was performed for the most part by Lieut. R. McLane and Lieut. J. P. Jenkins of the Navy Department, working with the advice of Dr. E. L. Mack of the Ithaca office.

The data on recovery and segregation of various alloying elements in steel has been incorporated in Bulletin 199, now in course of publication. The work for the Navy was finished in the late fall of 1920.

Adding 30 feet to the length of a church, by rolling the church facade forward to its new site

Moving the 1000-Ton Front Facade of a Church

IN olden days when the medieval cathedral builders wished to lengthen one of their great churches (and this happened very frequently), there was nothing for it but to pull down the western wall with its two towers, if it possessed any, or the eastern face, and lengthen the structure to the desired extent.

Today, however, thanks to the highly developed art of "House Moving," we can lengthen a church without any preliminary destruction of its principal front. As witness of this attention is drawn to this striking photograph, for which we are indebted to Mr. Gustavus T. Britt of Buffalo, which shows the front of the Central Presbyterian Church, Buffalo, which he moved 30 feet eastward to permit a lengthening of the auditorium to that extent. The front of the building is 78 feet wide over the lateral buttresses, 65 feet high, and 8 feet wide at the thickest parts. The weight of the wall as moved is 1000 tons.

The preliminary operations consisted of removing the front steps, preparing the new foundations, 30 feet to the eastward, and making a clean cut through the roof and through the side walls where they abutted against the church front. While this was being done the front wall was jacked up upon rollers. The work of moving the 1000-ton mass was done by means of screw jacks, operated by 15 men, and the wall completed its journey of 30 feet without injury in 10 hours.

Stoking the Employee

Why Scientific Feeding in Company Restaurants Is a Benefit to Both Parties Concerned

By Charles Frederick Carter

MECHANICAL stokers for steam power plants having proved such an unqualified success it was inevitable that some genius should adapt the idea to human beings. The distinction of being the first to install a mechanical stoker for feeding employees belongs to the Westinghouse Electric and Manufacturing Company which has tried out the plan at its great works at East Pittsburgh, Pa and found it good.

Now do not jump at conclusions violent hands are not laid on workmen while prepared food is forced from a tube down their gullets as geese are fattened for market. While the essential feature of the mechanical feeder for workmen is a moving belt on precisely the same principle as the conveyor which moves coal into the furnace the coal can not help itself but must go along the conveyor whereas the worker can and does retain liberty of action within certain limits. Such mechanical control as is brought to bear upon him is psychological rather than physical.

This truly modern innovation was suggested by the perplexity of the average human being when suddenly confronted with the momentous decision between pudding pie or prunes for dessert. No sympathetic person can witness without emotion the anguished indecision on view at the service counter of any busy cafeteria. Proprietors of cafeterias catering to the general public may fume inwardly when hungry lines are held up while some vacillating soul weighs the rival attractions of cream puffs and chocolate eclairs but they are obliged to dissemble their feelings lest they drive away trade.

But the case of a great manufacturing company charged with the responsibility of seeing that several thousand workmen obtain their midday meal and get back to their benches within the 45 minutes allowed for lunch is altogether different. Delays in such a case are not to be thought of. So when the Westinghouse Company built its enormous cafeteria at East Pittsburgh moving belts were placed in front of the service counters on which patrons rested their trays instead of sliding them along a rail in the usual leisurely way while selecting their lunches. The theory amply confirmed by experience was that while it would be possible to hold the tray stationary and let the belt slide along beneath in ninety nine cases out of a hundred the patron would respond to a subconscious urge to keep step with the mechanical pacemaker.

So strong is this urge that the motorman who stands at the controller can accelerate the belt 25 per cent and rush the line through at corresponding speed in case of necessity. It has been found by test that an average of 34 persons a minute can be served with the aid of the moving belt which is from 33 to 50 per cent faster than the average speed in other cafeterias. To be sure it sometimes happens that a workman fed past the steam tables on the gallop may snatch a plate of beans when his heart had been set on stew thereby darkening his outlook on life for the rest of the day and perhaps affecting unfavorably the quantity or quality of his work. But it is better for the company that an occasional disappointment of this character should be suffered than that scores should go without any lunch at all. The balance is decidedly in favor of the belt.

Serving-counters at the lunch club in a large factory. Note the aisle arrangement

Nothing in the foregoing is to be construed as intimating that this corporation or any other treats the matter of providing lunches for employees in a spirit of levity. On the contrary the lunch problem is a serious and important one. Rather tardily the discovery has been made that while man can not live by bread alone neither can he live without it. It is now pretty generally understood that a warm appetizing wholesome meal at midday has a direct bearing on health efficiency and dividends while employees who eat cold unsatisfying and poorly balanced rations at a dirty workbench are decidedly not as profitable as they might be made. However willing the worker may be he simply can not put energy intelligence and interest in his task without proper food any more than a boiler can generate steam without fuel.

The result is that much study and a good many millions of dollars are devoted to providing lunches and often other meals also for employees. While some of the more progressive employers established lunch-rooms years ago the exigencies created by war conditions compelled a sudden and very great increase in the custom. Once established, the employees' lunch-room has demonstrated its usefulness so emphatically that it has never been abandoned, but, rather improved and developed.

A survey conducted by the Department of Labor, while far from complete, indicated that more than half the industrial establishments in the country employing any considerable number of workers maintain lunch-rooms. In the great majority of cases the employers assume the first cost of the lunch-room or building and its equipment, as well as maintenance, and charge a price for meals intended only to cover actual cost of food and service, but usually resulting in a deficit.

The employees' lunch-room is too new to have become standardized, or even to have developed any outstanding practices. There seems to be almost as many different opinions about the most practical way of serving meals to a large force in a limited time as there are corporations serving them. For example the Department of Labor, in a survey embracing 228 establishments which served lunches for employees, found 30 cases in which the management was turned over to outsiders and 18 in which employees had assumed the responsibility of catering for themselves in quarters provided and equipped by the management. The great majority of employers prefer to keep so important a matter under their own control.

Often the lunch room is the product of a gradual evolution beginning with coffee and milk served free by the management to wash down the cold contents of the dinner pail. The next stage is likely to be the addition of free soup to the free beverages.

From such a beginning it seems to be an easy step to furnish a spare room or at least a corner of the work room with tables and chairs where the workmen may eat with more comfort. Not long after this stage has been reached the management may be expected to decide that it is worth while to erect a building fully equipped as a restaurant to serve lunches and other meals if necessary. At least it has worked out that way in a good many instances.

The desirability of lunch rooms for employees being so widely recognized and methods of administration being so chaotic perhaps the practices of some great corporations may be of interest.

The U S Steel Corporation, for example, operates 78 lunch rooms in some of its plants. Results have been so satisfactory that a committee was appointed some time ago as a preliminary to extending the lunch service to study the subject of buildings and equipment and make recommendations for standard practice. This committee has recently completed its work, and a second committee to make a similar study of operation has been appointed. Small lunch rooms and enough of them distributed around the plant so as to be within convenient reach of all have been found more desirable than a single large building serving thousands.

One feature of steel mill work which had a bearing on the decision in favor of small lunch-rooms [illegible]

A moving belt at the serving counter—a means of speeding up the [illegible]

Our Subconscious Selves

Have We, Right at Hand, an Explanation for a Large Class of Psychic Phenomena?

By J. Malcolm Bird

THE phenomena to which the term "psychic" has been loosely applied are of two sorts, with a fairly distinct line of demarcation. On the one hand we have occurrences whose whole sphere of action lies in the human consciousness, which are devoid of demonstrable effect upon the external world or of visible connection with that world. On the other side we have the production of definitely "physical" effects by "supernormal" agencies.

The present discussion aims to catalog the more significant of the phenomena which fall in the non physical category, and to supplement this with a few general remarks. Some of the items will be at once recognized as "psychic," others will not be so clearly of this character. For while we can with some success draw a line between the psychic phenomena which involve the minds alone of those concerned and the ones which bring in an actual physical effect, the psychologist well knows that in his field the normal shades imperceptibly into the supernormal, and the latter appears merely to be the former extended or accentuated. We shall therefore not attempt this separation, but shall permit the normal to overflow into our discussion when it will.

The supernormal phenomenon whose existence will be least disputed by the hard headed person who pooh poohs the whole subject is hypnotism Indeed it is not to be asserted with certainty that this is supernormal We are all more or less susceptible to suggestion To any suggestion that comes to us we ordinarily apply the critical faculty We inquire whether it is in line with our wishes, whether there is logical reason for or against it, so far as we are able we examine it on its merits. Perhaps the only difference between the hypnotized and the unhypnotized person is that the ability of the former to do this is suspended His ordinary cerebral associations inhibited, the hypnotic subject naturally and automatically responds to any suggestion put to him. It is not necessary that this be in the form of a command Since he has no power to reject it, it may come in any form at all but the impressive character of the performance is heightened by giving it as a command The medical man who uses hypnosis, however does not command his patient to ignore his ailment or abandon his vicious habit he merely tells him that he has not got it, and the suggestion is accepted

At the point where the operator acquires the necessary dominance over his subject this argument has been left blank it tells what the hypnotist does but not how he does it Here, if at all the process is supernormal. But we all know persons whose suggestions carry great weight with us, and are ordinarily accepted. The hypnotist has perhaps found a wholly normal way to make himself appear irresistibly in this light to his subject. The less commonplace alternative will appear later

Closely parallel to hypnosis are numerous phenomena where the subject may be regarded as having hypnotized himself. The practice of crystal-gazing has been universal. Stripped of all hocus-pocus, it comes to this: A respectable percentage of humans find, on concentrating the gaze upon certain objects and striving to make the mind a blank, that pictures appear in the visual field. The object of the gaze may be a ball or crystal of [illegible], quartz, etc., a bowl of water or anything [illegible] the impression of clearness and depth, a [illegible], a slab of polished stone, a mirror a [illegible], etc.; even the empty hand sometimes suffices. [illegible] either can induce these pictures, in [illegible] he may discover the ability by accident, or [illegible], in which case he may stare his eyes [illegible] nothing will happen. This makes it easy for [illegible] the pictures to discredit the [illegible], but there can be no rational disbelief [illegible] as outlined. The pictures seen [illegible], but the general style of art [illegible] is fairly uniform. [illegible] pictures. [illegible] which many of us have when half awake Probably more of us are subject to this than to crystal-gazing With closed eyes, between sleep and waking, we see faces, landscapes, all manner of things I am able to distinguish between visitations of this sort and true dreams by my ability to command the waking vision I cannot induce or dismiss it at will but once given the picture I can control its behavior and am usually conscious of so doing This is the only psychic experience to which I am subject.

Of rarer occurrence, but undoubtedly genuine so far as its subjective character to the percipient is concerned, is the true hallucination of wide-awake consciousness. Occasionally auditory this is usually visual The apparition, ordinarily of a dear friend or relative presents itself, lasts for an indeterminate period and vanishes It may be of a person known to be living or known to be dead in either event it may present the appearance of life or of death. It may speak or be silent it may remain motionless move at random or act a part It is seldom, if ever recognized as hallucination until it has passed—not always then

The subjective mechanism of all this is simple enough We have certain sense organs with their lines of communication and their associated brain-areas which receive and interpret their messages It is difficult to get away from the supposition that these circuits are electrical in nature Ordinarily they are closed to the action of any other stimulus than the sort they are designed to receive But it is far more difficult to imagine that this insulation is absolute than to suppose that at times the circuit is subject to extraneous influence of some sort, And just as extraneous currents in a telephone circuit set up sound waves at the receiving diaphragm, it seems fairly inevitable that external currents in, say, the visual circuit must set up visual impressions at their receiving terminus. The character and intensity of the extraneous factor would presumably determine whether associative as well as perceptive centers would come into action, and accordingly whether the picture seen would be a more or less familiar one. The nature of the extraneous force acting would, of course, determine whether the phenomenon would have to be regarded as normal or as supernormal; of this we are not quite ready to speak

Touching hypnotism from another angle is multiple personality. This condition is never induced, never in any way at the sufferer's command. It is suggestive of the introduction from without of the extra personality, and the possession of the victim's physical and mental structure thereby. The fact that in authenticated cases there has ensued a struggle between the two identities for ultimate possession has been cited in behalf of this viewpoint But in recent cases treatment of dual personality has taken the direction of a successful effort to aid the merging of the two streams of consciousness and this makes the phenomenon look more like a strictly subjective one

The theory that an external intelligence may be operating upon the corporeal rind of the subject links multiple personality with automatic writing Here again we have a phenomenon lending itself readily to deception, and nothing is to be gained by ignoring this. But nothing is to be gained either by holding out against the obvious fact that in a majority of cases automatic writing is without the operator's volition It may occur when he is in a trance—spontaneous or induced pathological or healthy or when he is apparently normally awake His attention may be on the writing on something else on nothing at all He may be conscious of the message as it develops of words as they are formed individually but not of the context or of nothing at all in connection with the message

Things completely forgotten may be recalled through automatic writing Rarer but far from unique are cases where knowledge is presented by the automatist writer which it seems certain he could never have had Persons of mediocre attainments display literary ability or exhibit mastery of subjects with which they have plainly never been in contact The penmanship is ordinarily that of the agent but often a distinctive hand is adopted for these communications Occasionally the same automatist will employ several of these keeping them apart without confusion Sometimes the hand of living or dead persons will be imitated

With appropriate modifications to meet the different operating details practically everything said of automatic writing applies to oral mediumistic communications We do not have to accept these as from the dead but we must accept the fact that many of them are without fraud and without volition on the part of the agent

With all these phenomena the same question arises The picture seen in the crystal in the waking dream or as an outright vision the extra personality that appears and vanishes the message of pencil planchette or voice are these mere phantasies without significance or do they represent a real message of some sort? The attempt to answer presents numerous difficulties passing these for the moment it leads us at once to one further important psychic manifestation of the mind alone—telepathy

We all know what this term covers We must all realize that its very name implies a simple straightforward explanation of the puzzling occurrences listed above But—does telepathy exist itself Its occurrence is admitted by its supporters to be usually spontaneous failure of attempts to operate consciously and with intent is not necessarily conclusive against it The direct experimental evidence in its favor consists in part of trials in which direct transference of thoughts images or sensations was attempted in part of successful hypnotism at a distance which fairly defies explanation on any other ground and in some part of the very fact that thus is simply explained much that without telepathy must for the present go unexplained Aside from fraud in any independent test of telepathy precaution must be taken against accidental reception of the desired information —thus if one think of a number hard enough the lips are apt to form it unconsciously and the recipient may with equal absence of knowledge or intent read this message It is also necessary to guard against the operation of chance If I draw a card and you try to name it, you should score one success in 52 attempts in 2700 tries two of the 52 successes that are coming to you for this period ought to occur consecutively You will have to do much better than this over a considerable period, before I shall admit anything beyond a run of luck

When we check up the possibility of telepathy by investigating the reliability of the reports rendered by other psychic phenomena which might be due to it

INCREDULITY may go to lengths as absurd as credulity The man who believes nothing at all is as impossible as the man who believes everything One who will not credit the occurrence of the phenomena which for want of a better title we group under the term "psychic" has made a vice of skepticism, and in its name rejects what is true but unwelcome If we but remember that we can accept the occurrence of these things without committing ourselves to any particular explanation of them, the admission that they really do occur loses its sting

If he were asked whether he believes the explanation which, borrowing from others, he has outlined in this article, the author would answer frankly that he does not know It may be objected that he has treated the subject more sympathetically than this state of mind would warrant We do not see that he has suppressed anything unfavorable to the hypothesis with which he deals, and after this, it seems to us that if this hypothesis is to be exhibited at all, it should be presented with some sympathy Aside from any question of actual acceptance, the author is the more inclined to give this sympathy because, to his mind, the hypothesis of his text is vastly to be preferred to any explanation involving the direct action of departed personalities Unless and until it is shown that it contradicts itself or contradicts something else that we can less afford to give up, it covers the ground so completely that work in other directions is really without point As stated in the text, it is for this reason alone that it is put before the readers of the SCIENTIFIC AMERICAN *as part of our series on the psychic* —THE EDITOR

we meet another difficulty One who is at all subject to apparitions is likely to have them more than once. It takes real strength of mind to remember the vague ones and the ones that did not come true, to give these a place of equal importance in memory with the ones that actually marked the death of a husband or a father Moreover any one has quite vividly in mind, from time to time the *thought* of a loved one If some day such a thought turn out to have coincided with a crisis in the loved one's life, this occasion is all too likely to get remembered as a true apparition, while its hundreds of meaningless but at the time equally vivid predecessors are completely forgotten. So an actual census showing what purports to be the ratio between meaningless apparitions and those that turned out to have significance will be misleading unless *corrected to take up this error in reporting*

Without giving space to actual experiments, precautions, corrections, etc, it may be stated that all the investigations suggested by the preceding have been made, and that as a result there appears to be fairly conclusive evidence *that a means of communication* between two minds exists, outside of those that involve the ordinarily recognized senses. Some persons seem to possess the power of transmitting or receiving at will, with the large majority, either aspect of telepathy is spontaneous, when indeed it occurs at all Definite suggestions as to the physical mechanism of telepathic communication are of less significance here than certain of its existence or non-existence

The present evidence is altogether in favor of its existence *Granting this* existence, the bearing upon all we have said is so plain that I need go into no details to make it clear that we have available an explanation for all the phenomena mentioned above. It has been objected that if we attribute all these phenomena, *without reserve, to telepathy it seems necessary to* grant that the telepathic faculty can search the minds of all the world and help itself to what it wants, for numerous messages are recorded which gave facts, subsequently verified, that nobody present could possibly be conceived ever to have had or which no one person in the world could ever have had in their entirety But has not the difficulty been magnified?

F W H Myers was the first to formulate, partly from normal and partly from supernormal phenomena the idea of the subconscious mind, the subliminal self In his hands the concept took later an unfortunate turn toward actual spiritualism From this fate it has been rescued by other psychologists, and restored to at least controversial standing. Numerous differences of opinion naturally surround such a subject Without regard to these, without intent to support the theory definitely in any way, we may set down its general features.

Our minds are dual Everything that takes place above the level of consciousness can equally take place below The subconscious element of the mind is in every respect as capable as the conscious—it takes charge, when necessary of all the mind's functions. In many ways this duality is as pronounced as though we possessed two distinct personalities

The subconscious is always "aware," if we may use the term, of everything that goes on in the conscious mind, of every impression that comes to the latter In addition, it takes in much that goes clean past the conscious mind without making any impression whatever

The subconscious is always in complete contact with the conscious. Only at times and under exceptional conditions is the current reversed, so that the conscious can tap the subconscious. When these exceptional conditions are met, things that have been below the threshold rise above it and we become conscious of them—perhaps for a second time after a period of complete forgetting (distinguished from the mere dismissal from mind of the things we can recall at pleasure), perhaps actually for the first time

Extreme advocates are apt to claim that the subconscious never forgets. I do not find this as objectionable as it might at first glance appear but it is not really necessary It can be displaced by the wholly innocent hypothesis that the subconscious forgets with comparative rarity; in some respects, this might meet the observed facts of psychic phenomena—particularly their uncertainty—better than the alternative of infallible subconscious memory.

The subconscious mind would be the seat of the telepathic function as regards both sending and receiving. Ordinarily, of course, we should be quite unaware of the process. Our subconscious minds may be ever accumulating a store of impressions received from other minds—received in some way that we understand as little as Archimedes would have understood a wireless concert, but of which we may hope we are on the path toward an understanding And then, when conscious comes into contact with subconscious—under conditions which in our present crude state of knowledge we need not even attempt to define—anything which is in the subconscious, anything which it has ever received and retained, may come forward into consciousness. Perhaps the choice of what shall thus come forward is made in some orderly way by the subconscious, perhaps it is largely a matter of chance—just as, when in a reminiscent vein, anything whatever comprised in our store of ordinary memories may, at random, come to the top.

If we may grant all these assumptions, we have a perfectly normal and scientific explanation for any psychic phenomenon which my imagination is capable of picturing For nothing that I ever knew is really lost if I can but establish contact with my subconscious half at the moment when I want to know it. And nothing which anybody else may ever have known can be proved to have been lost. Anything which was ever in any mind may have been passed on to another, and another, and another, and there is absolutely nothing to prevent it from turning up in your subconscious mind, or mine—and some day, when conditions are right, from rising above the threshold!

The present problem of psychic research, as I see it, is to investigate every link of this chain with the utmost care If it can be overthrown at any point, let us find this point overthrow it, and start all over. If it can't be overthrown we need carry psychic research no further, everything that can happen is accounted for Simple telepathy for most things, coupled with the necessary contact between the recipient's conscious and subconscious minds. For the more mysterious items, telepathy carried through a series of subconscious minds—as many of them as you please the property of persons who have died since delivering this message. If a message were to be received today from Julius Caesar, giving information which we could be sure none but Caesar ever had and which we could verify with certitude, it could be explained without a [illegible] if this hypothesis be admissible. Caesar unconsciously passed it to A, and A to B, and B to C, and so on to the present generation, when for the first time it rose above the level of consciousness of one of its recipients!

Foolish? Maybe so, but it is at least self-consistent. If you prefer to believe in ghosts, that is all right, too, but you must make as plausible a showing for the ghosts as this theory makes for itself. Improbable? No more so, as I see it, than lots of the amply verified phenomena which we are today called upon to explain —and which we can explain by its aid. In any event, it is not to be disposed of by calling it names, or by expressing repugnance for it, or on mere metaphysical grounds. It explains a lot of things that need explanation, and until it is conclusively shown, on scientific grounds, to be impossible, a lot of people are going to go right on believing in it It does, indeed, as a writer in the "Britannica" remarks, put a hopeless burden of proof upon any alleged ghost. Incidentally, if you did not know that the "Britannica" took this subject seriously, refer to page 940 of the index volume, and read some of the articles there listed under the head "Psychic Research" Finally, do not forget that we have a body of attested phenomena which make it clear that somewhere there is something that we do not know about, why, asks the advocate of the theory I have outlined, may this not just as well be in that indefinite thing we call the mind, as anywhere else?

When the patient's jaw was so undershot that he could not bite, he was supplied with an artificial jaw in front of the natural one

A Novel Trick in Dentistry

CONFRONTED by a patient with such an overshot jaw that it was impossible for him to make contact between his upper and his lower jaw, Dr A. Pimienta, a New York dentist, designed a dentition which gives the subject in question a normal "bite," without demanding the extraction of his natural teeth The photograph at the head of our second column shows how this result was achieved A sort of artificial jawbone was built up beyond the limits of the natural one, and an ordinary set of false teeth mounted on this. The natural teeth, instead of being removed, were left in place behind the artificial ones, with a light rubber dam about them to keep them out of mischief. The jaw thus treated was the upper one, the under jaw required no modification at all So new is this artifice that Dr Pimienta has been able to get protection on it, and his patient is in the unique position of having a patented mouth.

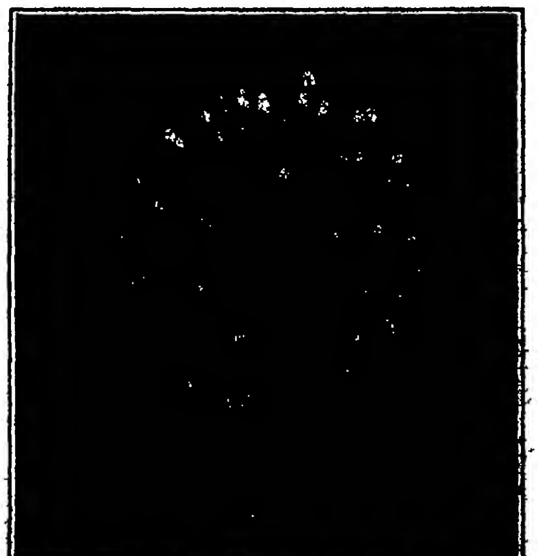
Cucumber-Flavored Water

ALL city water has at all times a large micro-organic content It is the function of the water-supply authorities, of course, to keep the supply under continual service in the interest of excluding actual disease-bearing germs. But there are vast multitudes of bacteria that are not pathogenic The bulk of these are quite neutral to the human system, so that their presence or absence is a matter of indifference. Some of them are actually beneficent. The remainder are not actually harmful in the same sense as are disease germs, but on some other ground are objectionable. Thus, certain species, when present in unbelievably small numbers, impart a noticeable flavor to the water

New York has recently had quite a siege of this sort of thing. For a long time there had been a curious, mildly objectionable flavor to the Croton water—described by some as merely "dry," by others as "tasting of the pipes," and by those of more delicate palate as resembling cucumber During the early winter it got so much worse that many restaurants and homes were obliged to buy spring-water for drinking purposes; and the cucumber quality became unmistakable.

We illustrate the micro-organism synura, which is responsible for all this. It is in every way harmless, but it discharges into the water an oily substance which is directly responsible for the objectionable taste. The only way to prevent this is to prevent synura itself. The organism is an extraordinarily rapid reproducer, but the introduction of copper sulphate into the water kills it fast enough to catch up, ultimately, with its powers in this direction. The process is a slow one, however, and in the case of New York it was several months between the initial attack and the final subjection of the little nuisance.

As our photograph indicates, the [illegible] live in groups, attached to one another, so that the [illegible] colony looks somewhat like a [illegible] The fine, hair-like whips are for the [illegible] motion; the entire colony moves as a [illegible] lash the water. Further details of [illegible] and [illegible] creatures may be found in the [illegible] American for [illegible]



A colony of synura, responsible for New York's recent trouble with her water

Cars That Carry Their Own Turntable

A NUMBER of automobiles equipped with flanged wheels for operation over the rails of the Hetch Hetchy Railroad are equipped with turntables by means of which the automobiles can be turned end for end. The turntable consists of a fifth wheel, mounted under the center of the car, to which two pieces of heavy angle irons are attached. Jacks are placed under these angle irons and supported on blocks. The driver then raises the automobile until the wheels will clear the rails. He then places blocks under the angle irons and removes the jacks. The driver then swings the automobile about until it faces in the opposite direction. After the car is turned around, jacks are placed under the angle irons and the car is lowered to the track, when it is ready to proceed. Chains are used to prevent too great expansion of the springs of the pony trucks when the weight is removed from the wheels.

In order to operate the automobiles with absolute safety to the public, three separate and distinct sets of brakes are provided—the service brake, operated by a pedal contracting on each rear wheel, the emergency brakes, operated by hand lever and expanding on drums on the rear wheels, and four brake shoes, operating one on each wheel of the pony truck.

One of these trucks is equipped as a mail and express car and one is fitted up as an ambulance with a removable stretcher. This stretcher is carried under the roof of the automobile. One of the cars is especially equipped to haul passengers and tourists. A railing runs around the top where baggage is carried. A steel ladder gives easy access to the roof.

This summer for the first time tourists are being carried over the Hetch Hetchy Railroad in these automobiles. The scenery along this route compares favorably with the Canadian Pacific and Royal Gorge Railroads, and has aroused the greatest enthusiasm from all who have taken the trip.—By *C W Geiger.*

Gasoline railroad-cars that carry a turnable and make a switchback unnecessary

The Cementing Qualities of the Calcium Aluminates

THE four calcium aluminates, $3CaO.Al_2O_3$, $5CaO.3Al_2O_3$, $CaO.Al_2O_3$, and $3CaO.5Al_2O_3$, which are the only anhydrous compounds of lime and alumina, were prepared in a pure condition by heating together the proper proportions of these compounds. After microscopic examination had shown that homogenous compounds had been formed, the products were finely ground and their cementing qualities when gaged with water were determined.

The two compounds higher in lime reacted very energetically with the evolution of much heat, acquiring practically instantaneous set. The two compounds higher in alumina reacted with water more like Portland cement, but showed higher strength at early periods than the latter. It was thought desirable therefore to prepare these in larger quantities and containing such impurities as silica, iron oxide, and magnesia, which would generally be present in lime and alumina of natural origin. The two compounds $CaO.Al_2O_3$ and $3CaO.5Al_2O_3$ were consequently burned in a 2 by 20 foot rotary kiln, varying their composition so that the silica, iron oxide, and magnesia reached limits of 17.38, 3.10, and 3.06 per cent, respectively, as maxima in a series of eight cements. The process of manufacture was entirely similar to that used in the production of Portland cement.

The ground cements were used in making the usual small tension and compressive test pieces and 6 by 12-inch concrete cylinders used of 1:1.5:4.5 and 1:3:9 proportions. The striking feature of the data obtained from testing these at different periods up to and including 3 years was the very high 24-hour strength. The rich concretes prepared from four of the cements developed in 24 hours strengths in excess of 2800 lb per sq in, and the lean concretes from two of the cements gave strengths beyond 1500 lb at the same period. Consistent gain in strength was obtained up to 1 year, when one of the cements in the rich concrete gave a strength of no less than 8220 pounds per square inch.

Test pieces stored in water tended to show retrogression in strength with age. This was also noted with test pieces stored in the damp closet, but to a much less degree. This action may be explained by the fact that the products of the hydration of all the aluminates are a hydrated $3CaO.Al_2O_3$ and hydrated alumina (except in the case of the anhydrous $3CaO.Al_2O_3$, when no hydrated alumina is produced). This latter is the cementing agent in these products, and, being colloidal, it is very susceptible to moisture changes. Large amounts of moisture are taken up in the presence of the latter with consequent swelling of the colloid and reduction in strength.

Still Oil Engine for Marine Propulsion

THE Still oil engine constructed by the Scotts Shipbuilding and Engineering Co., Greenock, for use on shipboard, and tested by a deputation of engineers representing the French Government and commercial interests, is said to be the largest of the type so far constructed and is of the slow-running marine type designed for merchant service. The Still engine is a combination of oil and steam engines. The main source of power is oil, consumed within a cylinder on the down stroke. The steam is generated in the cylinder jacket and forms a supplementary source of power used on the up stroke.

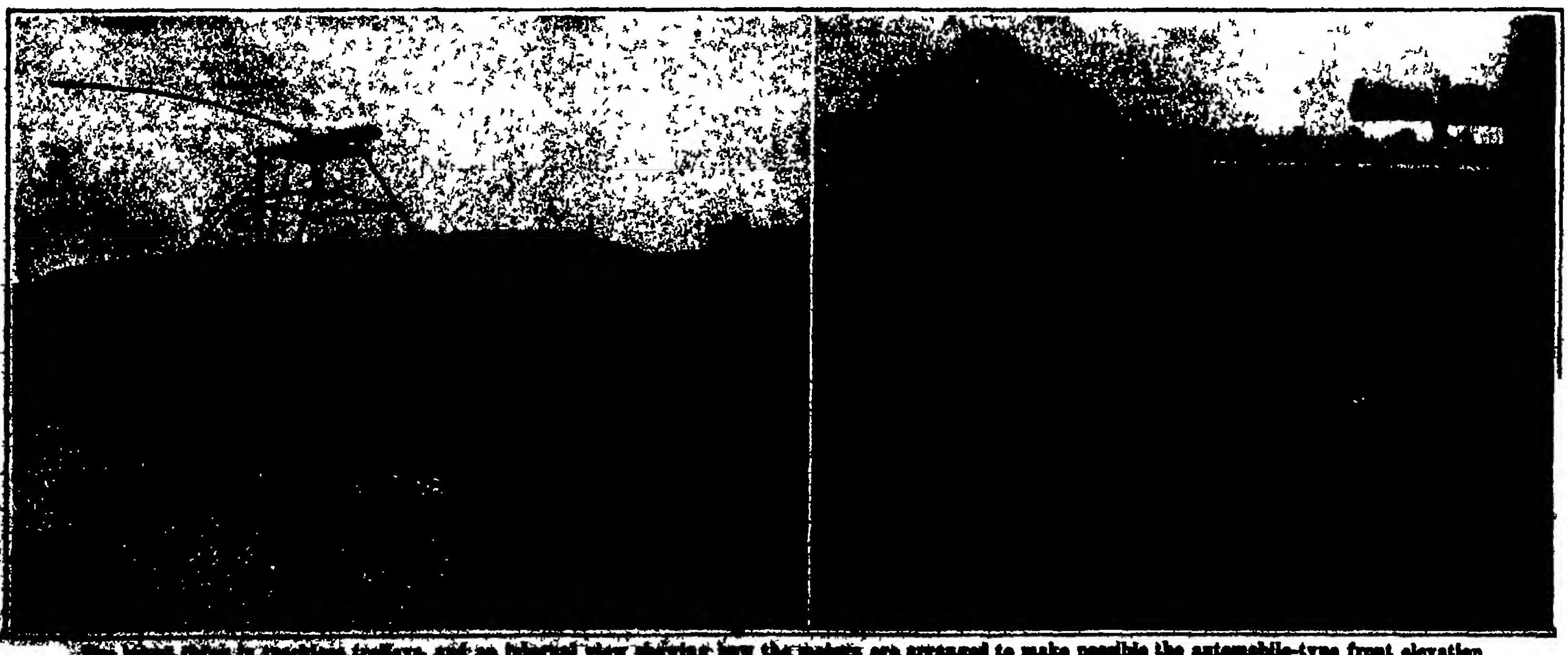
The present engine has the following main dimensions: Stroke 36 inches, bore, 22 inches.

In trials in May, 1921, the following efficiencies were obtained. At full load the combustion indicated-horsepower efficiency was 44.8 per cent, engine brake-horsepower efficiency 80.4 per cent, and net brake-horsepower efficiency 87.7 per cent; the respective efficiencies at half load were 40.2, 38.5 and 35.8 and at quarter load, 46.1, 34 and 30.0. The total oil consumption per indicated horsepower-hour was found to be lower than in a good Diesel engine, or at full load 0.360 pound per brake-horsepower hour, 0.398 pound per brake-horsepower-hour at an overload of 11 per cent, and as high as 0.47 pound at quarter load.—*Engineering (London)*

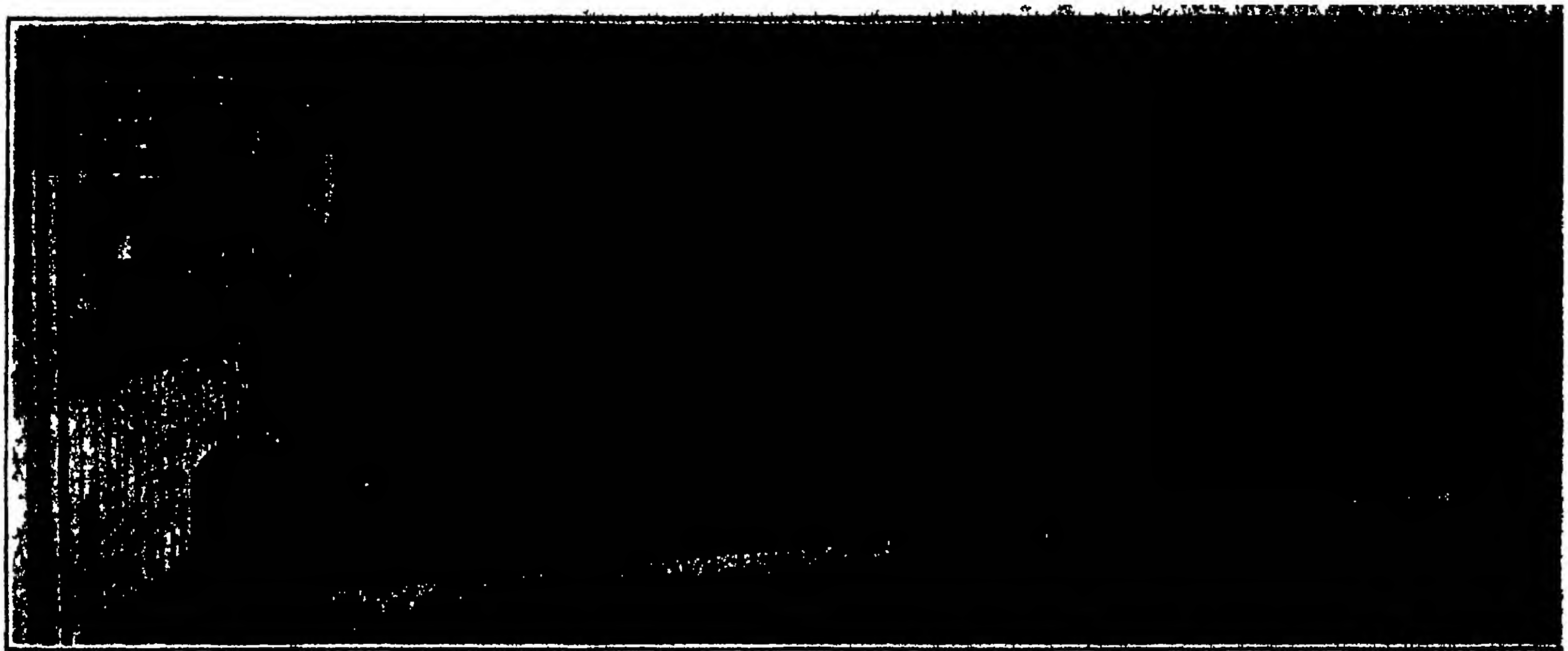
Electric Trackless Trolleys That Look Like Automobiles

A GASOLINE bus adapted to electric drive and used as a trackless trolley is the latest development in electric traction progress. The driving motors and control apparatus are placed beneath the hood of the car, which is retained, and to all outward appearances looks like the front end of a regulation gasoline car. In fact the bus is interchangeable between electric or gasoline drive, as desired. One of these busses was recently given trials at the General Electric plant in Schenectady and has been sent to Detroit for demonstration on the Municipal Railway lines in that city.

Two standard 600-volt railway motors connected in tandem furnish the motive power and are supplied with current from two overhead wires by means of a sliding type collector mounted on a special trolley base raised above the roof of the car. The bus speed is about 23 miles per hour, maximum. The bus weighs 11,740 pounds, is 25 feet long, 88 inches wide, and seats 20 passengers and a driver. The trolley pole is mounted on a semi universal joint, so that it restricts the maneuverability of the bus little if at all.



The latest thing in trackless trolleys, and an interior view showing how the motors are arranged to make possible the automobile-type front elevation



The largest chlorinating plant in the world, where New York City's water supply is purified. The control panels automatically regulate the flow of chlorine gas and of water flow, keeping the former constant regardless of tank pressure or temperature

Peace-Time Jobs for Poison Gas

How Chlorine and the Other Members of the Family Have Been Put to Honest Work

By Harry A Mount

TO those who have followed even in a casual way the development of armaments during and after the war it is apparent that any future conflicts will be won as much with poison gas as with bullets and bayonets or with airplanes and battleships. And yet these same poison gases which are so effective in war have a peace-time value even more significant

It would be a mistake to attribute all of our late progress in chemical industries to the stimulus of war but it is true that there is hardly a department of industrial chemistry which has not been directly affected It is true also that some of the most deadly of poison gases, developed for the single purpose of war are now serving the most peaceful of purposes. It will be the purpose of this article not to outline our chemical development but to show how new uses for these deadly gases are constantly being discovered and to point out some of the newer applications.

The peace-time work on poison gases in this country has been mainly along two lines One is the development of coal tar derivatives and the other is in finding jobs for chlorine and its compounds. It is hardly necessary to point out the enormous progress that has been made in the manufacture of coal tar products, especially in the matter of dye making But this progress has been largely of a technical nature and consists in working out problems which German chemists had solved years ago The importance of this work can hardly be overemphasized but it does not hold the spectacular interest of the other line of development—that of finding jobs for chlorine—for in this latter activity new and important fields have been explored.

Chlorine was the first poison gas used in battle by the Germans, and it was the basis of many of the most toxic gases developed later The properties of chlorine were fairly well known before the war and already it was used to a limited extent for bleaching, for purifying water supplies, etc

Chlorine has come into almost universal use for purifying the water supply of cities. At the present time some 2025 American communities use chlorinated water consuming 4,000,000,000 gallons of water daily and serving a population of 40,000,000. One important result is seen in a reduction of 70 per cent in the death rate from typhoid in cities from 1913 to 1919. (The last date for which figures are available.) During this same period the typhoid rate in rural districts decreased only 20 per cent.

Originally these applications of chlorine were made in the form of chloride of lime, of which the active agent is chlorine. Such installations, however are now being rapidly replaced by apparatus for the use of liquid chlorine.

Chlorine gas is one of the derivatives of common salt obtained by electrolytic action A saturated solution of clean brine is piped to a group of cells through which a current of electricity flows at low potential. The salt is decomposed into two elements sodium and chlorine The sodium is formed at the cathode and in reacting with water forms caustic soda. The chlorine gas is freed at the anode from which point it is drawn off through a system of piping to a liquefying plant It is dried compressed and refrigerated and stored in steel cylinders in which it is available to consumers The liquid gas exerts an internal pressure of about 150 pounds to the square inch on the tank at room temperature and it is evaporated into a pure gas immediately upon being released from the cylinder

Aside from its most important use in purifying water chlorine gas in this form finds wide application in bleaching processes, chlorine being the active agent in most commercial bleaching solutions Great quantities of the gas are used in textile and paper mills laundries, etc for this purpose

One of the more recent uses is in sterilizing city sewage to render it harmless before discharging into a stream or lake and in similar treatment of trade wastes. Many tanneries now use chlorine as a weapon against the anthrax germ so deadly to humans. A field recently invaded is the sterilization of swimming pools. A small quantity of chlorine will render the waters of a pool absolutely sanitary saving the expense of emptying the pool and refilling it On a great pool completed recently in Washington D C, a small boat is fitted with a unique chlorinating plant and it plies the waters all day long, discharging chlorine, when the pool is in use. A similar experiment has been tried at Cleveland, where the waters of a public beach are chlorinated by a plant in a small boat. It is claimed that one application will remain effective at the beach for several days.

A Yale professor has recently made the discovery that bad odors can literally be gassed to death by the use of chlorine. His method is to release a measured quantity of chlorine gas into a stack carrying the odorous air A combined chemical and electrolytical action takes place, and a few feet from the point of application the air in the stack is found to be free of odor. The importance of this discovery may be realized from the fact that through its application the height of a stack planned to carry away odors from a sewage disposal plant in Cleveland has been reduced from [illegible] feet to [illegible] feet. In many cases it will be possible to [illegible] the odor from garbage, sewage and trade-waste disposal plants which now create a public nuisance.

Every well-equipped hospital now has a small plant, consisting of a chlorine cylinder and special control apparatus for the manufacture of the Dakin-Carrel solution This solution was used in the military hospitals for the sterilization of wounds and has proved so effective that it is now standard in civil hospitals. Chlorine also is the base of several household sanitary solutions sold under widely advertised trade names.

A number of interesting experiments with new uses for chlorine are being carried forward. In one of these a large packing concern is investigating the possibility of using highly chlorinated water in packing fruits and vegetables This eliminates part of the cooking and helps preserve the natural flavor At least two other important discoveries in the application of chlorine of great commercial importance have recently been made, but their nature can not be revealed at this time.

It must not be imagined from the foregoing that uses for chlorine are being developed to the exclusion of the scores of other gases developed for war use. One of the most interesting of recent applications is the use of ethylene instead of acetylene for welding. It is said to be more satisfactory for this purpose and a welding outfit which can be carried on a man's back is practicable because the weight of a solvent for the acetylene is dispensed with

Several of the most deadly of the war gases have been found valuable in the most gentle of peace-time pursuits—the making of perfumes. From the deadly phosgene a violet scent is extracted more delicate and more lasting than the woodland flower yields. Benzyl acetate yields a jasmine scent as fragrant as the jasmine itself

Dinitrophenol is the basis of a new American sulfur-black dye of very great importance. This is the most important of the dyes because it finds a wide application in dyeing such articles of wear as hosiery. It was one of the dyes which German chemists were confident we would never produce, but [illegible]

[illegible]

[illegible] ... to attack with [illegible] and [illegible] parts of the Philippines, [illegible] parts of the United States. There [illegible] in combating the cotton boll [illegible] of the South, but this problem has not been [illegible].

[illegible] has been given recently to tests of the [illegible] of tear gas in the handling of mobs. Indications are that this harmless but exceedingly effective [illegible] will largely replace machine guns and clubs in [illegible] emergencies.

We have sketched here only a few of the more important uses to which poison gas is being put. There are literally thousands of new applications and everywhere in industry these are facilitating industrial processes, creating new products, bettering old ones, and reducing costs. Perhaps we shall yet have reason to be thankful for the day the Germans released over a stretch of Flanders trenches a cloud of greenish gas that broke the spirit of the bravest men and sent them reeling and coughing in retreat.

A Warning Concerning the Peace-Time Use of Army Gas Masks

WARNING that the Army gas mask, while capable of giving protection against the deadly gases met on the battlefield, does not protect against all the gases or atmospheres encountered in mines, in the industries and in fire-fighting, is given by the United States Bureau of Mines.

The dangers from gas that city firemen face and the need of standardized methods of protection against them have been pointed out The need of a knowledge of such gases on the part of city firemen has been especially emphasized by overconfidence in the capacity of the Army type of gas mask to protect the wearer against industrial gases, an assurance that has probably arisen because soldiers were taught that the United States Army gas mask would protect them against all the gases they might encounter This statement true for the battlefield but not true for all industrial gases including products of combustion has been brought back by soldiers and spread generally among workers. Furthermore, city firemen and mine operators have been circularized with letters and advertisements of Army gas masks offered for sale by certain persons who made unreserved statements, probably through ignorance, that the masks would protect wearers in mines and burning buildings The falsity of these statements was evident to the Bureau of Mines, which took steps immediately to notify the public that Army gas masks had serious limitations, especially when used in fire-fighting or in any place where unusually heavy amounts of poisonous gas are present This warning has been verified by the actual experiences of some city firemen who have tried Army masks. On the other hand, the excellent qualities of the masks have also been demonstrated at fires.

Whether or not firemen should adopt the Army gas mask for general use has been much discussed Theoretically it would seem that the half hour oxygen breathing apparatus, which keeps out all gases and supplies oxygen, would be much safer than the gas mask for fire-fighting. But practical experience shows that firemen, as a rule, do not favor oxygen breathing apparatus. To them it seems cumbersome and uncertain in action The combination of oxygen cylinder breathing bag, regenerator canister, valve and pressure gage appears too complicated for the rough and ready work of fire-fighting. Although such apparatus has been on the market for a number of years, it is seldom put into practical use, even when on hand at fires Firemen prefer to take their chances unencumbered or at most simply to tie a wet handkerchief or towel over the nose and mouth to keep out some of the smoke

Therefore the utility of the gas mask must be considered from the practical point of view rather than the theoretical. A review of the many reports of tests in experimental fires by city fire departments shows That firemen are favorably impressed with the simplicity of the gas mask and will wear it that in the great majority of these tests it protected the eyes and throat from irritating smoke and was a great improvement on sponge respirators and wet cloths that the mask did not encumber the wearer or retard his effectiveness in fire-fighting that no special training was required in learning how to use the mask that in comparison with the oxygen-breathing apparatus very little attention is required to keep the gas masks in good condition

These experiments by fire departments corroborate the experiments of the Chemical Warfare Service and of the Bureau of Mines in proving conclusively that the Army gas mask when fitted with a canister containing cotton filter pads, activated charcoal and soda lime effectively filters irritating smoke particles and in addition protects against most chemical fumes in the concentrations likely to be met in fires.

However in using the Army mask the following serious limitations must be kept in mind It furnishes no oxygen hence it should not be worn into a place where a safety lamp or a fireman s oil burning lantern will not burn it should not be used where there is reason to suspect carbon monoxide as in smoldering fires in basements and other confined unventilated spaces and especially in confined places where broken illuminating gas pipes add carbon monoxide to the air it offers very poor protection against ammonia finally the Army mask may break down in unusually high concentrations of poisonous gases • It was originally designed for outdoor use where the poisonous gases are considerably diluted with air Caution must be used therefore in going into rooms where the concentration of the accumulated gas may be great enough to pass through the mask

Perhaps the most serious limitation of the Army mask for fire-fighting is its inability to protect against ammonia and carbon monoxide. Although special ammonia canisters are now available commercially and carbon monoxide canisters soon will be available the fire-fighter does not know in advance what gas or combination of gases he may find Many buildings contain ammonia refrigerating plants and all cities outside the natural gas belt are piped for artificial gas containing carbon monoxide. The fireman, therefore must have, in a single mask, protection against all these gases. Enough progress has been made by chemists working under the direction of the Bureau of Mines, and subsequently in the Chemical Warfare Service, in the development of an absorbent for carbon monoxide to raise the hope that a combination canister for a fireman's mask which will protect against smoke ammonia carbon monoxide and practically all chemical fumes, will soon be commercially available. When this is accomplished a fireman can be protected in any atmosphere where a safety lamp will burn

In order to promote the production of an adequate combination gas mask for fire-fighters the Bureau of Mines will cooperate with city fire departments in obtaining more accurate information as to the actual gases present in connection with fires, and with manufacturers of gas masks in testing and approving suitable gas masks when submitted to the bureau Fire departments desiring to cooperate in obtaining information on the presence of carbon monoxide in gases from fires should communicate with the Pittsburgh Pa., experiment station of the Bureau of Mines

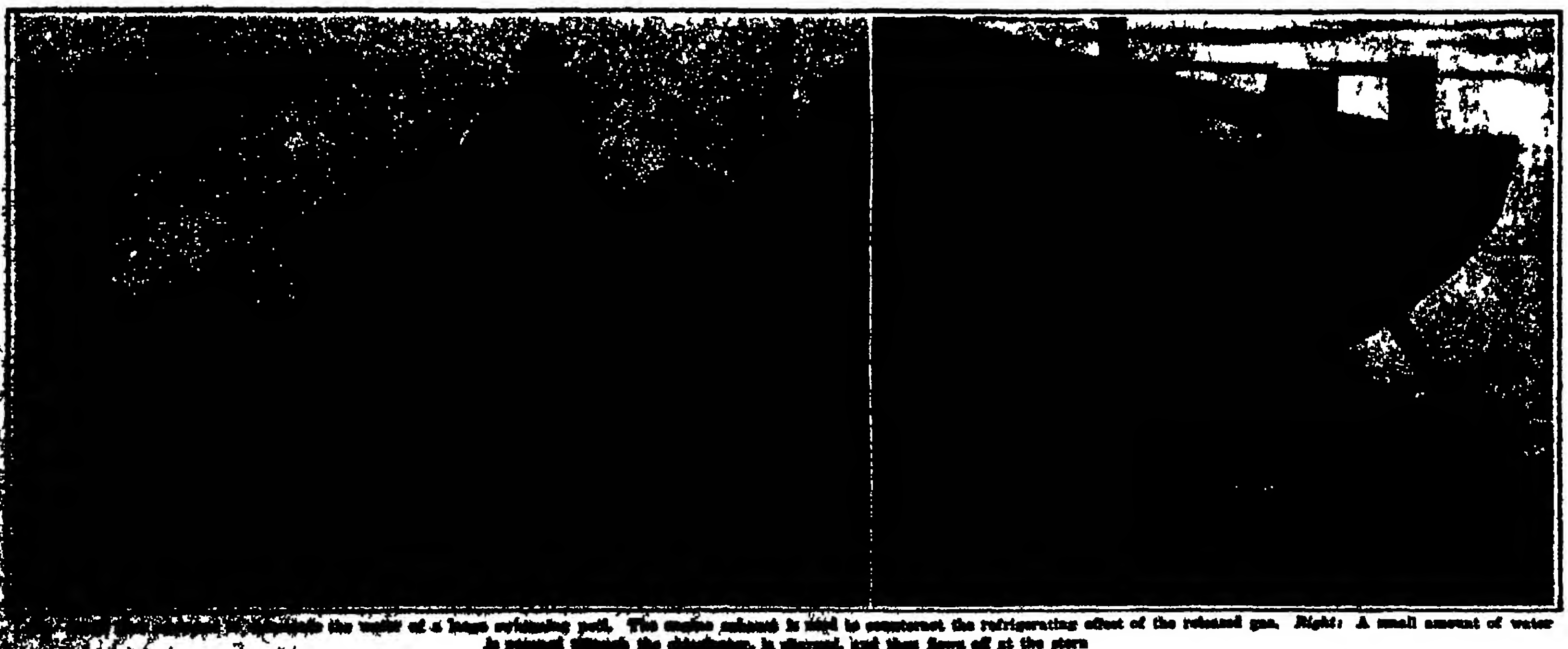
The ordinary Army gas mask can not protect the wearer from poisonous gases in a burning mine As a result of the experience of its engineers the Bureau of Mines recommends the use of self contained oxygen breathing apparatus by men doing rescue work in mines. If such apparatus is not available it is preferable to enter the mine without breathing apparatus rather than to trust to other types of breathing appliances The Army gas mask would give the wearer in the mine a false sense of security by removing distasteful fumes from the air breathed and allowing the carbon monoxide to pass through unnoticed The smoke and gases from fires in mines serve to warn the workers of the presence of dangerous gas

Detailed information regarding the utility of various types of gas masks and breathing apparatus in the presence of poisonous and asphyxiating gases encountered in fighting fires and in burning mines is given in Technical Paper 248 which may be obtained from the Director of the Bureau of Mines Washington D C

Testing Thermometers

A NEW edition of Circular of the Bureau of Standards No 8 entitled Testing of Thermometers, contains general information of interest to those who desire to submit thermometers to the Bureau for test Brief sections are devoted to the following topics The standard scale of temperature types of thermometers accepted for routine and special tests number and choice of test points test requirements and tolerances certificates and reports for laboratory thermometers reasons for refusal to test or to certify notes on the breakage of thermometers general instructions to applicants for tests behavior of thermometers and schedules of fees

This publication is now ready for distribution and anyone interested may obtain a copy by addressing a request to the Bureau of Standards until the free stock is exhausted

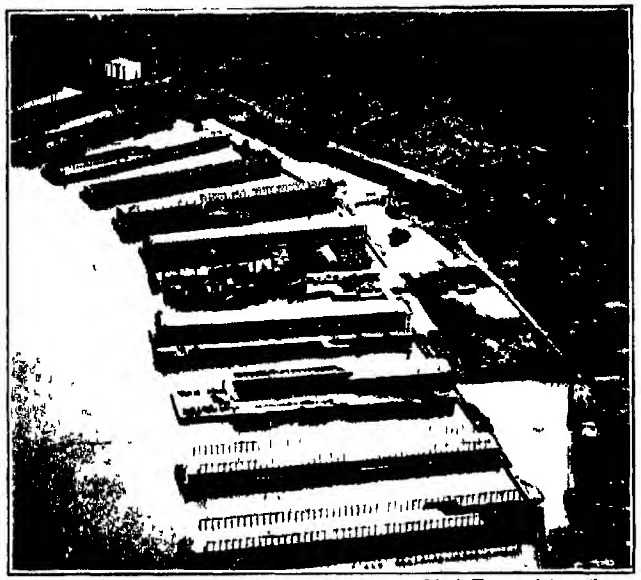


[illegible] the water of a large swimming pool. The engine exhaust is used to counteract the refrigerating effect of the released gas. *Right:* A small amount of water is pumped through the chlorinator, is charged, and then flows off at the stern

How Washington, D. C., keeps its immense new swimming pool fit to swim in

New York City's Staten Island Docks

Greatest Pier Project Ever Planned or Built at One Time in the History of Ocean Navigation



This view shows the fine stretch of twelve new city docks at Staten Island. The space between the new and old bulkheads is being filled in for tracks and warehouses

THE greatest single addition ever made to the pier capacity of the port of New York (or of any other port for that matter) is the long stretch of piers none of them less than a thousand feet in length which extends along the shore line of Staten Island to the south of St. George's Ferry between Tompkinsville and Clifton. This is an entirely new development all of the piers having been constructed simultaneously and well within a stretch of two years time. In width they vary from 125 to 200 feet, and in length from 1025 up to 1180 feet. The two widest piers, each 200 feet in width and 1029 feet in length, carry double deck sheds; the others are single deck.

The inauguration and putting through of this great municipal improvement is due to the former Dock Commissioner Murray Hulbert to whose efforts when he was a member of the House of Representatives is due also the appropriation of forty million dollars which is now being expended in blasting out the various reefs in the East and North rivers for the purpose of securing a uniform depth of forty feet. Work upon the new docks was commenced in May 1920 and was practically completed at the close of 1921.

In order to secure the benefit of deeper water and also to increase the area of level ground at the inshore ends of the piers a new concrete bulkhead was built one hundred to four hundred feet out from the old shore-line. The intervening space is now being rapidly filled in and will be utilized for the construction of warehouses and other buildings appropriate to a great terminal such as this. Also upon this made ground and upon the adjoining shore will be established the large trackage which will be necessary to accommodate the ten to twelve million tons of freight which these new piers will be capable of accommodating in times of active shipping operations. The situation of the piers and the position of the old and new bulkhead lines are clearly shown in one of our airplane views of the whole dock improvement.

Although these piers have been criticized on the ground that most of them are of insufficient width, and because they carry only single-deck pier sheds, the city authorities have stated that these two features were incorporated in response to the wishes of the steamship companies who were to become the lessees of these piers. The plans were submitted to them and the dock commissioner was informed that these were the kind of piers that these companies wanted. It should be noted that one great disadvantage which hampers operation of most of the existing piers of the port of New York has been avoided in the Staten Island docks. We refer to the fact that a clear width of three hundred feet has been provided between adjoining piers, thus affording ample room for the use of lighters alongside the shipping and on both sides of the ships, if need be, at the same time.

Forty-four Acres Additional Pier Space

How great an addition to the pier accommodation of the Port has been afforded by these new works will be realized, when we state that the surface of the piers represents an aggregate addition to the city's pier capacity of forty-four acres, which represents an increase of the city wharfage suitable for transatlantic shipping, of nearly twenty per cent. The freight capacity of the twelve piers is estimated at fourteen million tons a year, which means that they can accommodate fourteen hundred 10,000-ton freight ships. Provision has been made for extending railroad tracks down each side to the ends of the double-deck piers, which will accommodate thirty cars at a time on each side. This means that freight can be discharged direct from car to ship, or from ship to car or if it be desired, direct to either deck of the pier-shed. Because of the great length it will be possible for two 500-foot ocean steamships to berth at one time on each side of the piers.

Piers Served by Electric Cranes

As will be seen by our illustration the double-deck piers are served by eight Gantry cranes on each side of the pier. These cranes will have a capacity of lifting 2½ tons with a single fall, and 5 tons with double lines. The outer legs of the gantry run upon rails parallel with the edge of the pier platforms, and the inner end of the gantry travels upon a rail carried along the face of the pier shed. These cranes can thus be moved to a position opposite any desired cargo hatch of a ship. Their booms can swing through 180 degrees, and cargo may be moved from ships' holds to the dock, or to the cars, in either direction. With an average load of 1500 pounds in a sling, each crane is geared to sixty cycles an hour, a cycle being the time from lifting a load until the load is laid down. This means that each crane can transfer 45 tons of freight an hour, which the Dock Department claims is double the average freight discharge at the present Manhattan Steamship piers. On the single piers two tracks for freight run down through the center of the sheds, and they are served by a dozen electrically operated deck winches and cargo masts.

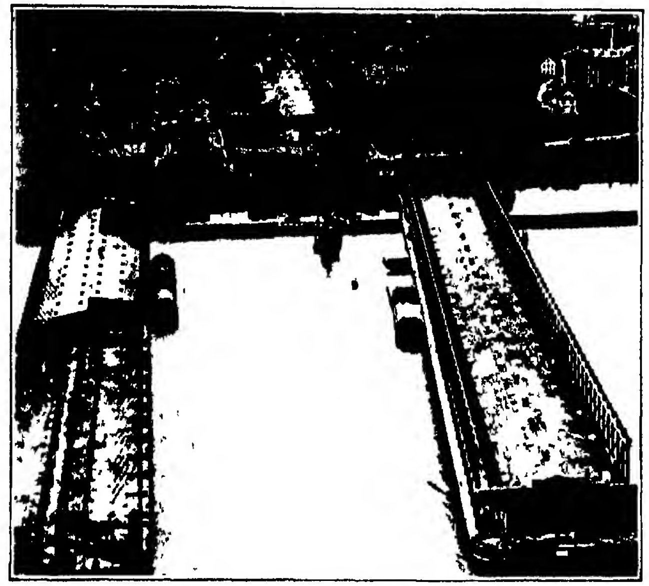
The Storage Warehouses

We have referred to the group of warehouses which will be built on the filled-in ground at the inshore ends of the piers. To serve these, tractors, hauling six to eight trailer cars will carry the freight between the piers and the warehouses. On the double-deck piers elevators of 12 tons capacity will lift loaded trucks from the lower to the upper floors. At the shore-end of the piers there will be truck and car scales. The equipment of the larger piers will cost about $900,000 each, and the small piers will be equipped for about $450,000. A coal and oil bunker pier will be built convenient to the system, so that ships may re-fuel without loss of time.

An essential part of this development will be a generating plant for light, heat, power, and refrigeration. All the cranes, winches, and elevators of the 12 piers will be electrically operated by power distributed from this station. In short no feature that characterizes the equipment of the latest and best of the great dock systems of the world will be wanting in the Staten Island improvement when it is finally completed. The total outlay for the piers, and their upland approaches, will be about $50,000,000. Evidently, if the port of New York is to reap the full benefit of this great improvement, it must be adequately connected, not only with the trans-continental railroads that reach New York but with the various sections of the great metropolis itself. At present there are two schemes that have been proposed—one by the Port Authority and the other by the City Administration. The Port Authority plans to build an inner belt line about a mile back from the New Jersey waterfront which shall intercept all the roads which reach the Jersey side of the Hudson River from the west and south. This belt line will be connected with a freight tunnel, which will pass under the upper bay to Brooklyn and an extension of the belt line will be carried across the Arthur Kill and down to Stapleton and the new docks.

The other connection, as proposed by the City Administration calls for a belt line sweeping around through New Jersey, at a distance of 20 miles back from the Hudson River, crossing the Arthur Kill not far from Tottenville, and running down through Staten Island to the new docks.

Whichever plan is adopted this much is certain that the very first construction undertaken should be that of making the necessary first-class heavy track connections with this great $50,000,000 improvement of the city. Until such connection is made it will be impossible to reap the full benefit of this great outlay of the city's funds.



Airplane view of two of the Staten Island docks, showing the wide basin between them—a characteristic feature of this improvement

Details of one of the two-deck piers at Staten Island. These piers, over 1000 feet long, can accommodate two 500-foot ships on either side. They are served by eight electric gantry cranes on each side, of five tons capacity

Waterproofing Fabrics by the Aid of Electricity

FOR many reasons it is important that the clothes we wear or the fabric that we use for industrial or domestic purposes be able to resist the passage of water through its texture. Originally there was just one way of making cloth waterproof and that was to impregnate it with rubber. This is known as the mechanical method of waterproofing, and while it is still used and possesses many advantageous features, it is not suitable for making waterproofed garments, as any one who has worn a rubber coat will testify. There is no ventilation possible in such a coat, and its wearing leads to bodily discomfort.

The chemical process of waterproofing, which consists in precipitating an aluminum soap on the fibers of the cloth, affords good ventilation and is used largely in making waterproofed fabrics for fashioning into garments. The process is simple and consists merely in soaking the cloth in a highly concentrated soap solution and then passing it through a solution of an aluminum salt. A reaction takes place whereby the aluminum soap is precipitated on the fibers of the cloth and as this substance is insoluble in water the cloth is waterproofed. The disadvantage with this method is the coating of aluminum soap dries and crumbles away from the fabric. The ability of the cloth to resist water is then destroyed.

There is a process which is being worked successfully in this country at the present time in which the electric current is used in the waterproofing of cloth. The process is based on the use of the current to electrolyze a solution of the aluminum salt in which the fabric, which has been treated with the soap solution is introduced. The claim is made that by this process not only is the surface of the cloth given a coating of the aluminum soap but the inner capillary structure of the fabric is filled with the soap as well, that is the interspaces between the fibers are closed up with this insoluble material. The process consists in passing the fabric, which has been treated previously with a solution of a sodium soap between a graphite cathode and an aluminum anode which is entirely surrounded with a heavy woolen pad. The solution of aluminum acetate flows over the cathode. The woolen pad secures a uniform degree of waterproofing.

Various changes have been made in the arrangement of the parts of the apparatus which is used to accomplish this waterproofing action and lately the main difficulty that of getting over the seams in the cloth was overcome by relaxing the pressure on the rolls automatically when the seam is reached. This was done by an adjustment of the spring pressure forcing the rolls against the fabric. When the seam is reached the graphite bar electrode was made to move backward and upward and after it had passed the bar dropped back into its original position automatically.

After passing through the first electrolyzing bath the cloth enters a bath of water, where it is well washed and then it goes through squeeze rollers which squeeze out the water and into a second electrolyzing bath in which the position of the electrodes is reversed the anode plate being on top and the cathode bars below. This serves to subject the under side of the fabric to the waterproofing action. Silks and woolens require only two treatments while cotton goods must be put through four separate electrolyzing baths. Fabrics that have been treated in this manner have been put to severe tests and have proved to possess remarkable waterproofing properties.

Cutting Fluids

THE selection of a proper cutting fluid is a very important matter in connection with work in the machine shop. The lubrication of the tool and chip in turning and similar work is a difficult problem as the pressure between the surfaces of the tool and chip is high and as the surfaces of the two metals are naturally very clean, there is a pronounced tendency to seize. This is particularly true of soft steel and wrought iron.

Recently the Bureau of Standards has conducted a thorough investigation of this subject, consisting not only of laboratory work but of extensive correspondence with users of cutting fluids to obtain the consensus of opinion of those well able to judge the relative merits of various fluids in practical work.

Technologic Paper No. 204 of the Bureau of Standards has been issued covering this investigation and may be obtained from the Superintendent of Documents, Government Printing Office, Washington, D. C. at 15 cents per copy. The paper is divided into two parts, theory and practice, one covering the bureau's work on different classes of fluids and the other detailing the results of correspondence with various users. Among other things, it is pointed out that viscosity should not be the controlling factor in the choice of a good fluid. Adhesion is a very important point and in addition the substance must exercise a marked cooling effect on the work. The advantages of lard oil and blends in which mineral oil may be compounded to resemble the former product are described. The paper will interest those engaged in machine tool work.

The Ductless Glands

Recent Discoveries Concerning These Mysterious Regulators of the Human Organism

By Hereward Carrington, Ph.D.

THE past few decades have seen enormous progress in various branches of biological research—particularly in the investigation of the *mechanism* of the bodily and mental activities. Anatomy had progressed to a point where the detailed structures of the body were subject to the minutest investigation. But the question of the activities of the body functioning as a whole, was still subject to much doubt, and little was known of the nature of the dynamic forces which were at work in the actual operation of the body and its various separate organs.

It may be admitted at once that much is yet to be learned concerning these various processes. Science is as yet on the very fringe of the innermost recesses of life, and, while much has been discovered as to the body itself and its grosser forms of activity, little is yet known as to its "finer" activities, and those subtle energies which are manifested under abnormal conditions, or, for that matter, even during its ordinary processes of functioning!

Nevertheless, great progress has been made, particularly within the past few years, and this is nowhere more manifest than in the recent researches upon the activities of the ductless glands. The functions of the ordinary glands of the body, such as the salivary glands, the sweat glands, etc, have been long understood. All of these glands are provided with minute *canals*, or "ducts," which lead either to the *exterior* of the body or into the internal blood stream, and secrete certain substances whose nature has long been known. In addition to these however we possess certain "ductless glands," so called because they do not possess any canal or duct which conveys their secretion either to the outer world or into the blood stream direct. These glands have recently been shown to possess extreme importance, and, though they are very minute, their functions have been shown to be so necessary that without them we should soon die, and on the other hand, without them we should never have been enabled to grow up into sane normal human beings. These glands of internal secretion may be classified as follows.

The *thyroid* gland, situated in the neck producing a secretion named "thyroxin," whose function it is to control the rate of energy production in the body and also the growth of certain organs and tissues, particularly those connected with brain and sex. Over or under functioning of this gland produces certain abnormal conditions which have been studied extensively by physicians.

The *pituitary* gland, which is a tiny gland situated about the center of the brain, within a bony couch or cradle—forming as it were, a skull within a skull. (This shows the importance which nature attaches to this gland, in thus doubly defending it against accidents.) Small as it is, this gland has been shown to be divided, naturally, into two portions, the *anterior* and the *posterior*. The anterior pituitary secretes a substance known as "tethelin," which controls the growth of the skeleton and general supporting tissues. The posterior pituitary, on the other hand, produces a secretion known as "pituitrin," which governs or controls certain nerve-cells and involuntary muscles, and the brain and sex tone. The gland as a whole, in its activities, is also thought to govern the energy consumption of the body—just as the thyroid controls its production.

The *adrenal* glands, situated over the kidneys, are also divided into two portions the outer and the inner, known respectively as the "cortex" and the "medulla," like the brain. The adrenal cortex produces a certain secretion, known by its effects, whose ultimate or chemical nature is as yet unknown, but which seems to control, very largely, the growth of the brain and the sex-glands. The adrenal medulla, on the other hand, secretes a substance known as "adrenalin," which is perhaps best known to the general public of all these internal secretions. Adrenalin is that secretion which, when poured into the blood, fits the body for emergency situations which may arise through combat, flight, etc.

The *pineal* gland, also situated in the brain, was long thought to have no important function. The exact nature of the secretion produced by the pineal is unknown. But it has been shown by numerous observations that it has at least three important functions: brain and sex development, puberty and adolescence, maturity and the reaction of the body to varying degrees of light.

The *thymus* gland, situated astride the windpipe, and over the heart, is the gland of childhood, and it is this gland which "keeps children children," and whose activities prevent them from maturing too rapidly. The nature of the secretion which it produces is as yet unknown, but it has been shown that after puberty its activities practically cease, and the gland itself virtually atrophies and disintegrates.

The *gonads*, so-called, are the particular glands relating to sex life. They are, in fact, the sex glands themselves—the testes in the male, and the ovaries in the female. It has recently been shown that, in addition to their normal functions and external secretions, they are also glands of internal secretion and that they produce substances which, absorbed by the blood-stream, influence the characteristics of the body and particularly the so-called secondary sex-traits or characteristics.

The *parathyroids*, which are situated in the neck, behind the thyroid glands, and which also secrete a substance whose chemical nature *is as yet unknown*, have been found to exercise a dual influence upon the body and its activities. In the first place, they control very largely the lime metabolism, and in the second place they influence the excitability of nerves and muscles, so that a reaction which, in the absence of the inhibitory function of this gland, would be in the nature of an extreme shock, is reduced to a normal, nervous muscular reaction. The lime activities of the body have been shown to be of great importance, even to the extent of possibly determining the difference between the masculine and feminine skeletons, since the male has been said to be an organism with stable lime metabolism, and the female one of instable lime metabolism.

DUCTLESS glands, in these days when it is the fashion to make startling discoveries about the human mechanism, are very much "in." We hear a great deal of them, and we might be inclined to wonder how in the world we ever got along without them—that is to say, without knowledge of them and of the part they play in the organism. Dr Carrington attempts here a survey of the ground—he tells us just what these mysterious glands are, just what we know about them, and just what the more extreme authorities think about them. He closes with a word of warning against attributing to these glands, potent as we know them to be, more than is really their true function.—THE EDITOR.

Finally the *pancreas*, situated in the abdominal cavity, producing a secretion known as "insuline," has been shown to be the controller of sugar metabolism—so that abnormalities in the functioning of this gland are responsible for the disease known as "diabetes mellitus."

Knowledge concerning the *functional* activities of these glands has been acquired only within the last decade or two, and intensive work is still going forward in various parts of the world, in an endeavor to complete our knowledge of their important functions. It is now contended that the type and shape of the body, the stature and growth, the character of our hands, fingers and toes, the various facial types and expressions, the quality of the teeth, the character and coloring of the skin, the hair, the quality and color of the eyes, the nature of the muscles and the character of the sex life, of any individual, are all determined primarily and almost exclusively by the activities of these glands—the secretion of one gland, it is now believed, is counterbalanced to a great extent by the secretion of another gland of opposite and contrary characteristics—so that, in the normal human being, a balance or equipoise is maintained, and one set of functions or activities is not unduly stimulated at the expense of another.

Thus, when the thymus gland functions normally, it tends to prevent the child from growing mature at too young an age, and offsets or "antidotes," as it were, the secretion of other glands, notably the adrenal cortex, which tend to bring on premature puberty. Thus, a constant balance is maintained within the organism, and a normal human being, mental and physical, is preserved by the interaction of these various internal secretions, each playing with and against the other.

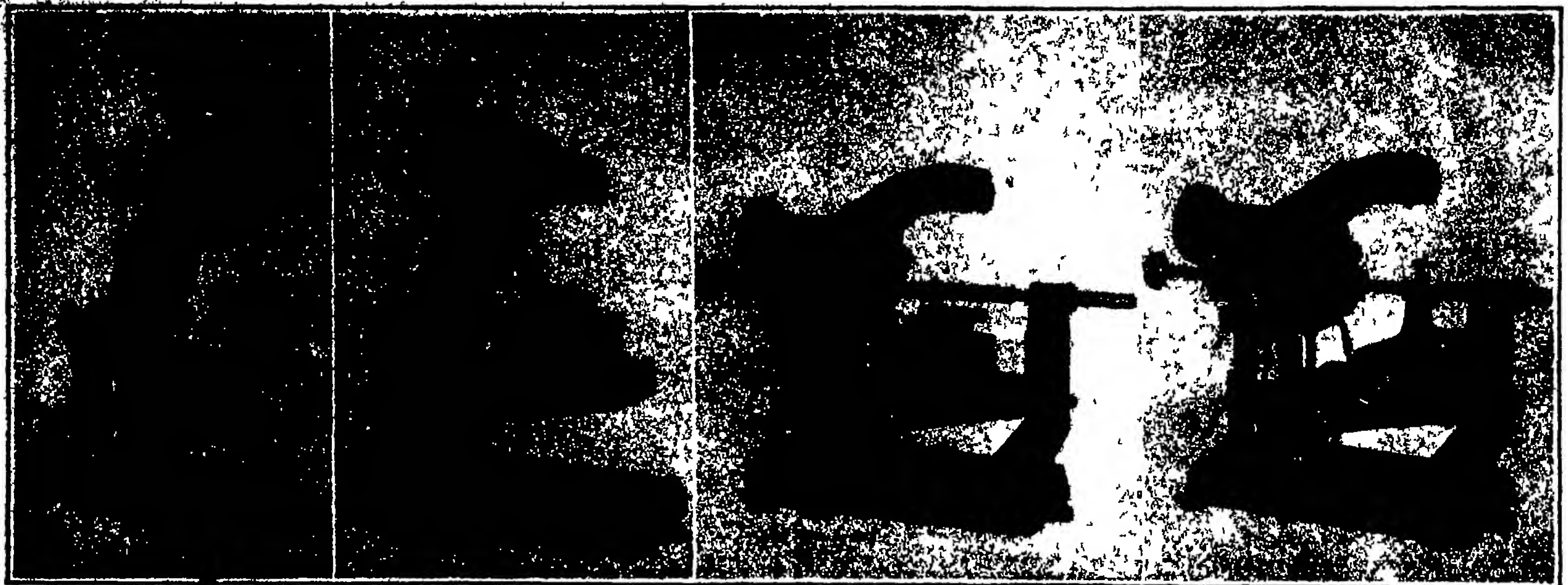
But perhaps the most striking characteristic of the "new psychology," based upon a study of the ductless glands, is that the character, personality and temperament of any individual are now thought to be due to the varied secretions of these glands! According to this new point of view, the brain has been developed as a specialized thinking organ by reason of the activity of certain secretions of the ductless glands, particularly the anterior pituitary. Our personality depends very largely upon *memory*; if there were no memory, there would be no personality. The mechanism of memory has been divided by different psychologists into various subdivisions, but these may roughly be divided into three group-factors—namely, recording, retention and reproduction (the latter including recognition). Materialistic psychology contends that memories are traces laid down in the brain, being recorded there somewhat in the same manner as music is laid down in a phonograph record, and it now appears that the thyroid may be chiefly responsible for the process of the laying-down of the memory trace. The pituitary, *on the other hand*, is said to be responsible for the *preservation* of the memory deposit. It is only natural to suppose therefore, that under these circumstances the varied personalities which we see about us are but expressions of the varying activities of the ductless glands, which show a predominance of one type, as opposed to another—thus constituting an adrenal personality, a pituitary personality, a thyroid personality, etc.

The aspect of the subject is, however, far more debatable than the purely physiological effects of these glandular secretions, which are now fairly well established. The theory that the purely chemical secretions of the ductless glands determine our entire mental and normal life, as well as our physical frame, may be questioned on several grounds, and until we know far more than we do at present of the inter-relationship of brain and mind, such extreme doctrines cannot be said to be adequately proved.

And this is quite true, even leaving out of the account the vast mass of "supernormal" phenomena — the evidence for which is being constantly accumulated in all parts of the world. It may be admitted, however, that these new researches on the ductless glands have thrown a profoundly new light upon the world-old problem of the nature of *life*.

A Menace to Fish Life

THE ever-increasing practice of discharging oil and tar wastes into streams and harbors, and its effect on fish and fish industries, is strikingly set forth in a pamphlet issued by the Bureau of Fisheries. The fatal contamination that results from poisonous substances rejected by gas plants and petroleum distilleries, or dumped from tankers and oil-burning ships, must result in huge losses of food products and money. First it should be distinctly understood that the presence of a minute quantity of poison is sufficient to kill. For example, the American sunfish, though highly resistant to poisons, will die in about an hour in water, 4 to 5 parts per million of phenanthene or naphthalene, or 5 parts per million of hydrogen sulfide, or 7 parts per million of ammonia; and, of course, very much weaker solutions will kill if the fish are exposed to them for several days. Aside from this direct toxic effect, such pollution repels the fish from approaching shore at the only time when they might be caught; sickens or kills bottom-dwelling species such as oysters; kills, by suffocation, floating eggs and delicate larvae; destroys minute plants and animals on which the larvae and adult fish subsist; affects aquatic life by diminishing the aeration of the water; and destroys spawning grounds. Even petroleum products that contain no poisonous substance soluble in water may, by agitation, form a deadly emulsion that will kill in five minutes. Tarred roads also send their poisonous washings into the smaller streams. Remedial measures may be found in the commercial recovery of oils from drainage water, in the prevention of gas-house and refinery pollution, with an increased use of wastes, and in regulations forbidding the dumping of oil from ships in harbors or near spawning grounds and feeding areas.



From left to right, these views show the machine in use as a drill-press, with spindle-head and motor vertical with the head swung at an angle for end-milling on work held in a vise, set for ordinary milling; and in use as a lathe, in quite the ordinary fashion

Four examples of the flexibility of the latest all-round shop machine

The Machine of All Work

A NEW combination bench-type machine which combines the lathe, milling machine and drill press has been recently developed by a New York machine-tool maker. The machine is motor driven and hand fed throughout, with the exception of the screw-thread-cutting operation. Anything that can be done on the bench lathe, the bench miller, or the drill press can be done on this machine. Among its great points of advantage are the adjustability for work at any angle. As one of our views makes clear, the head moves upon a graduated arc, and any desired angular adjustment is thus immediately available. At the same time the spindle can be fed out up to a distance of three inches by the handwheel that appears at the front of the head. Once fed to the desired point, it is locked in position by the lever that adjoins the handwheel.

The machine is motor driven and the motor is attached directly to the head so that power is supplied to the spindle when it is in either horizontal, vertical or angular position. There are six spindle speeds, the lowest being 90 and the highest 1150 r.p.m. These changes are obtained by shifting the shaft.

When the machine is used as a lathe, as in our fourth view, the spindle is made so as to hold either face-plate, spring collett, or chuck, so that a large variety of tools is usable. The three wheels for ordinary transverse, longitudinal and vertical feeding are grouped conveniently at the base of the arc on which the head travels. Micrometer dials are attached to all three, rendering the machine suitable for precision work. The carriage can be locked in any position. Tapers can be turned by moving the bed to the right or left of the spindle axis, and a lever is supplied to lock it in such positions.

When the head is swung up at an angle, as in our second photograph, and the milling operation is performed upon the work held in a vise, the tailstock is removed and the end mill is held by a spring collett in the spindle. The radial arm is graduated in half degrees, and swings a wide enough arc to bring it about that these half-degree marks are one-sixteenth inch apart, so that smaller units of a degree can readily be interpolated. The head is counterbalanced by a weight in the hollow column, connected to it by steel cables that run on pulleys.

Thread-cutting is done by the master screw method, no lead screw being used. The work is held in a chuck or spring collett, and while the spindle is revolving a handle holding a nut segment is placed in contact with the master screw, so that the spindle is caused to feed forward while the cutting tool remains stationary. At the end of the thread cut, the nut segment is thrown out automatically by the taper on the handwheel. The spindle is then returned to the starting place by handwheel. Internal threading is done in the same manner by using the appropriate internal-threading tool.

In our first view the machine is shown, with head and spindle vertical, in use as a drill press. Since the spindle is driven direct by gears a heavy cut can be taken when drilling, for there is no belt to slip. Vertical milling can also be done with the head in this position.

The machine permits of the bed being moved entirely out of the way for the accommodation of "cruel and unusual" work of any description. The base has three standard tee-slots to accommodate half inch bolts. Horizontal, vertical or angular work can be performed on work placed on the base, just as though the bed were in use.

This machine is rigidly constructed throughout to withstand the heavy duty for which it can be used. It represents a complete equipment, admirably adapted for shops having limited floor space. It is well adapted for small production work requiring angular drilling or milling operations, since many extensive angular jigs and fixtures can be eliminated by using the radial arm of the machine, with the spindle feed feature. It is largely the motor drive that makes the angular features possible and eliminates all countershafting.

Train Lighting in France Must Be Electric

TECHNICAL journals report that the French Government has decided to eliminate the use of gas as an illuminant on railway trains. The Minister of Public Works and Transport, M. le Trocquer, has issued a circular which decrees that after January 1, 1923, no gas lighting will be permitted on express trains. On suburban trains electricity must be used for lighting after January 1, 1924, and by the first of 1925 all trains operating in France must be electrically lighted.

The French Government in 1914 contemplated the eliminating from trains of all lighting except electric, but action was delayed by the war. Recent train wrecks however, where cars were set on fire through ignition of gas following upon collisions, have brought the matter to a head and emphasized the risk incident to the use of gas.

Safer Handling of Acid

EVERYBODY who has ever had anything to do with the handling of acid in the big, heavy glass carboys in which it ordinarily comes knows well that this is a delicate operation. Men do slip, do stumble, do encounter unexpected obstacles even when they are walking in regular course, with no load, and on an apparently smooth way. When they are navigating in a factory with its many corners and dark places, carrying a load of acid they are more likely to meet with such an accident and it is a far more serious matter when they do so.

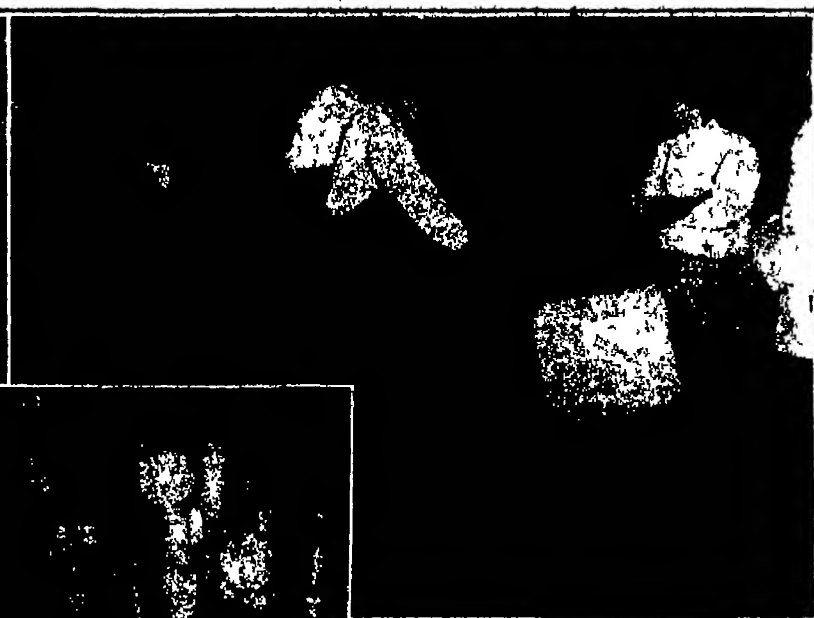
To take the peril out of a misstep on the part of the man who is packing acid about the premises, a Caldwell, N. J., equipment engineer has devised the carboy-carrier illustrated herewith. For all ordinary purposes the wheeled carrier is entirely practicable and is, of course, to be preferred when it can be used, since it divorces the man in the shafts pretty thoroughly from the possibility of getting burned, no matter what happens to his carboy. The forks in which the carboy sets are sturdy enough to hold it up against a very powerful turning moment and the use of two wheels in place of the wheelbarrow procedure which might have been a trifle cheaper affords a further safeguard.

For trundling the carboy over a course containing too many obstacles to permit the use of the wheeled carrier the extreme danger which such conditions necessarily imply is met almost as well by the two-man, two-handled carrier shown beside the other. The vastly improved stability got by this apparatus, as compared with more rough-and-ready practice familiar to all, is well exemplified by the little stunt which the two men in the picture are performing. If the carboy will not capsize under this provocation its suspension must be extremely stable.

With the use of these carboy carriers that is called for by the local conditions, the danger of accident in stevedoring acids is greatly reduced

Freezing Fish for Future Food

An Interesting Process Which Is Playing an Important Role in Our Food Supply



Left: Placing fish on ice-coated shelves of freezer *Right:* Washing and panning fish before they go to the freezer *Below:* Open storage of frozen and glazed fish

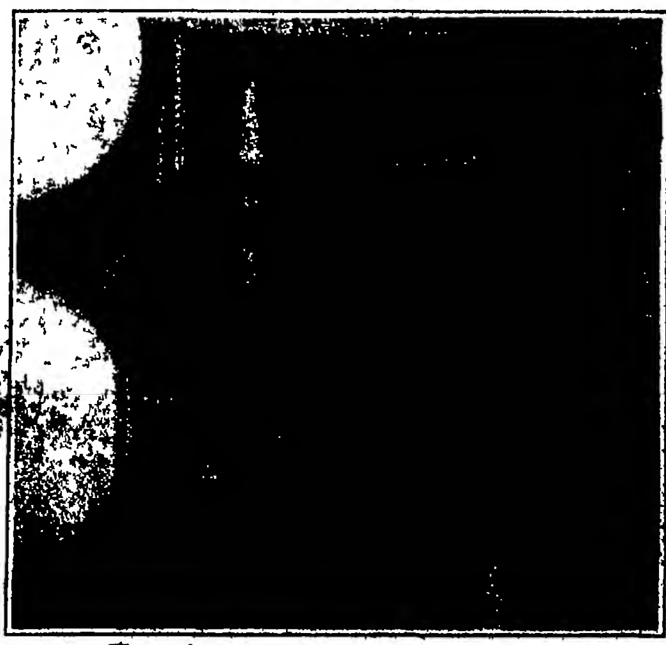
How large quantities of fish are stored, frozen, for future consumption

AMONG all the food industries which depend upon long term preservation of some sort to distribute their seasonal product over the entire year's consumption none finds the storage for long periods more vital than the fish industry *Fish is perhaps the most perishable of all foods,* as is evidenced by the care with which it is kept on ice even in the open display bins of the fish markets. And while some species are found all the year around, in many if not in most cases the season for the catch is a short one nor is it limited by any factor under human control The fish run when they run, and must be taken when they run Varieties like salmon may be put up in cans, the process leading to a seasonal industry in which the problem is that of securing labor for the brief interval during which it is wanted But more often it is necessary that the fish, when marketed, shall be whole fish and not mere canned fish meat, and this requirement is to be met in only one way—refrigeration

The primary source of the bacterial infection that spells decay is the gills, and all fish should have their gills and guts removed immediately on coming from the water After this there is the necessity for keeping them in good condition aboard the fishing boat till the latter reaches port This is often a matter of some days, even a couple of weeks Ice packs and freezing in brine at low temperature are among the methods here employed and the crux of the problem is getting the fish to the necessary low temperature without chilling them too suddenly

When they are finally got ashore they may go on the market at once or they may go into storage. In the latter event it is necessary to start all over again and prepare them for long storage as though they had never been chilled Our photographs illustrate the principal differences in procedure here The fish may be stored in open bins or shelves, in which event the prime requisite is that the carcasses themselves be thoroughly frozen Cod, haddock, etc, are frozen until they are of precisely the consistency of a cake of ice, they are then covered with a glaze, and laid down for the needs of the future Other species are sometimes packed with considerably more care, in a fashion which more nearly meets our ideas of what "refrigeration" consists in In this case, instead of actually making a separate process of the freezing, the fish may be laid away in a freezing atmosphere and left to the natural course of events. Small stuff like scallops is frozen and stocked in pails.

In most of the commercial fish storage plants, as in other food storage industries, the old-fashioned ice-house has given way to the modern refrigerating plant, where cold is produced, not by the mere melting of ice, but by more artificial processes involving the actual use of power and fuel. Our grandfathers would doubtless be puzzled by what would appeal to them as a contradiction in the statement that our final picture represents the engine-room in a refrigerating plant We, however, know what this means, and why an engine-room is necessary to maintain temperatures that are low enough to be unfavorable to the continued existence of the "bugs" of decay



The engine room in a great fish-freezing plant

Copper May Harm Illusive Vitamine

ONE of the causes of the deterioration of the vitamine which guards against scurvy is the catalysis or chemical action due to copper pipes. This was illustrated recently by an experiment described in a recent number of the *Journal of Industrial and Engineering Chemistry* by Mr Alfred F Hess. He says that milk heated in a copper vessel will lose considerable of the antiscorbutic vitamine, as compared with milk heated in a glass container

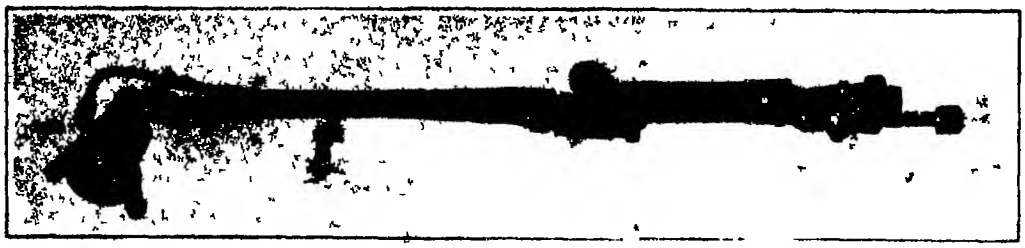
Guinea pigs receiving milk pasteurized in a copper vessel will develop scurvy, states Mr Hess, whereas those who have been fed with milk which had been heated in a glass do not develop the disorder That the signs and symptoms observed in the animals who had been fed with milk heated in copper were truly those of scurvy, was shown by the fact that they recovered when fed on orange juice The milk so heated only contained three to four parts of copper to the million parts of the fluid.

"This experiment," continued Mr Hess, "has a very practical application, for it is well known that milk in process of pasteurization passes through copper pipes. It is true that they are lined, but the lining frequently becomes defective after a short period Lined copper vessels are commonly used in the course of condensing and drying milk It is therefore not astonishing that copper is found very frequently in small amounts of milk In a British medical report it was found 11 times in 87 samples. It is impossible to state how important a factor catalysis is. But whatever may prove to be the scope of its application, an experiment of this nature shows the little suspected factors which may be introduced and which must be taken into consideration in relation to the destruction of this most delicate vitamine, and warns us that in the handling of food products containing vitamines we must consider the influence of every new industrial process.

"Quite apart from the question of the destruction of the vitamines, the last few years have demonstrated that we should not consider foodstuffs as entities from the standpoint of their vitamine content A food may be rich or poor in this factor according to attendant circumstances. For instance, carrots cannot be classed as containing a definite amount of antiscorbutic vitamine; if they are fresh they will contain much more than if they are old; or, again, if they have been plucked young they will have far more than if they were tough and old. We must avoid catalogueing foods too rigidly It is probably of aid to arrange them in categories and to assign them definite potencies, but we must remember that such a list possesses merely comparative and approximate value." Contradictory and puzzling results in vitamine investigations may receive much light from all this

A Match That Lights Under Water

"HAVE you got a match?" would seem a singular question under water, yet a Paris inventor has found a way to strike a light even there. If you should ask him what it is that can be lighted under water, he would say that gas pressure torches are now made to burn under water. Such are in fact the oxy-acetylene torches which are used for cutting up the iron plate of sunken vessels by their great heat. The great pressure of the gas prevents the water from putting out the flame, for it cannot reach the burner. But it may happen, of course, that the flame would go out by accident, and the diver would then be obliged to come up to the surface. With the new "match" he stays below and lights his torch. Certain metals such as potassium and others when placed under water will set up a violent reaction accompanied with heat or even flame. But other substances can be added which will aid in producing the flame, and if the proper mixture is packed into a small brass tube about the size of a cigarette and provided with a stopper, such as is seen just in front of the burner of the torch, all that is required when working under water is to pull out the stopper and allow the water to enter the tube, and the mixture then commences to burn amid the outrushing gas from the torch, so that we have exactly the same result as if a match had been applied above ground. A spring fixture holds the tube and also pulls it back out of the way of the torch flame when not in use.—*By Francis P. Mann*



Under-water match with which the diver can relight his gas-pressure torch, if this should accidentally go out

Sun Worship

THE London *Times* recently carried a news dispatch which indicates that a pet theory of the late Sir Norman Lockyer has just received a blow from which it can hardly recover. Accurate measurements made by the Egyptian Survey have proved that never since the great Temple of Karnak was built has the sun shone straight down its axis. Sir Norman Lockyer believed that this temple, and many others in Egypt, were constructed for the purpose of obtaining an exact observation of the precise time of the solstice—that is to say, the day of the sun's most northerly setting. But Mr. Richards, of the Survey of Egypt, has proved that the sun has *never been visible at all*, at any moment in any day in any year along the axis of the temple, since about 6000 B. C., and that it last set along the central line of this axis between 12,000 and 18,000 years ago. At this date Europe was still in the Old Stone Age, the cave period was at its zenith and the hunters of the Dordogne were chasing reindeer over the French tundras. To suppose that the Temple of Karnak can have been built then is out of the question. This would appear to dispose of the sun temple hypothesis, and the Survey of Egypt is to be congratulated upon a useful piece of work.

Portable Runway for Climbing the Curb

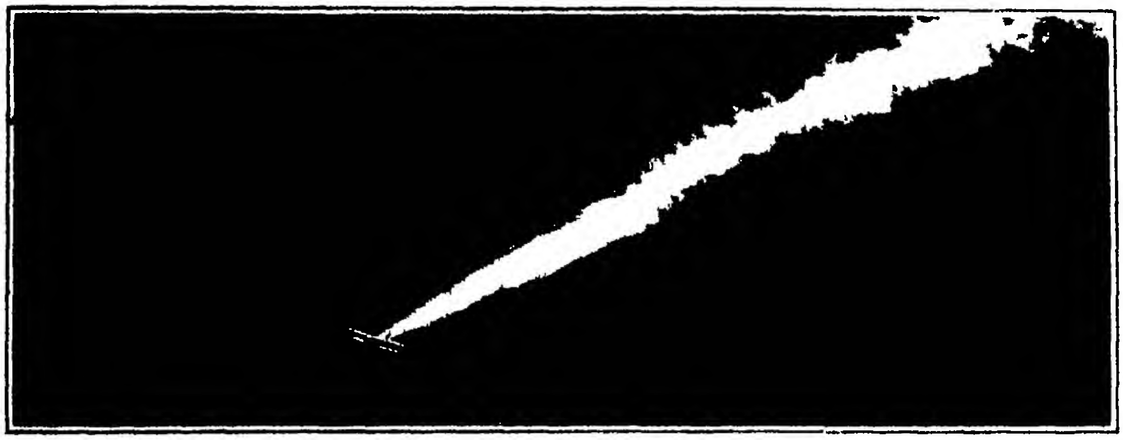
A RHODE ISLAND man has recently developed a device which will be found useful by automobile drivers who have to climb over curbings in order to get into garage or parking space. The device consists of two wooden runs which are connected in such a manner that they will fold together when not in use, so that they may be kept out of the way. Weighing only ten pounds, the unit is easily handled by any person, and when folded, its three feet of height does not take up much room. Its use is greatly to be preferred to the alternative of "rushing" the curb.—*By Allen P. Child.*

The portable runway to carry the car up the curbing, as it appears at the several stages of its use

Spraying Trees from the Air

IF we disregard the usefulness of the airplane in commerce and war there still remains a list of applications lengthy enough to justify its development. But even the airplane has its limitations: there are things it cannot do, and every agency which has had anything to do with aeronautics has had scores of such "silly" proposals.

It is not to be wondered then that practical flyers at McCook Field, the Army experimental station at Dayton, at once catalogued as in the "silly" class a proposal to spray trees from an airplane. When two flyers were assigned to the job of trying to do it, they undertook it with frank skepticism. It was not even considered worth while to make arrangements to photograph the "stunt." When the test was an unqualified success, there were no more surprised persons than the men who made it. They landed and telephoned back to the field for a photographer. He came—by air—and the test was performed again for the benefit of the camera with the result shown here.



Spraying from a plane: already the tail of the dust stream is beginning to settle among the trees

The proposal to try spraying trees from the air came from C. R. Neillie of Cleveland, who discussed it with H. A. Gossard, chief of the Ohio Department of Entomology. The cooperation of McCook field was asked in testing the idea. An airplane designer was assigned to the task of making some sort of apparatus for releasing "bug powder" from an airplane, and he made two sifters, on the principle of a flour sifter, arranged with sprockets and chain drive so that they could be operated from inside the plane. These sifters with flat hoppers were fastened on the sides of an airplane fuselage.

Mr. Gossard selected a grove of 500 catalpa trees on a farm near Troy, Ohio, for the test. This grove was literally "alive" with a species of caterpillar which twice before had practically defoliated the grove. The plane was piloted by Lieut. John A. Macready, who a few days later set a new altitude record, and E. Dormey, who designed the sifters, went along to operate them. The hoppers were filled with arsenate of lead powder. The two originators of the idea were already stationed at the grove to watch the results.

Upon reaching the grove, the plane flew just above the tips of the trees along the windward side of the grove, Mr. Dormey operating his sifters. The arsenate of lead was carried by the wind over the grove and then it settled down gently among the trees. The observers in the grove declared that the dusting from above was much more effective than spraying, for the reason that the dust started at the top of the trees and literally stripped the caterpillars off to the ground. Within a few moments after the "dusting" the ground was covered with dead caterpillars. The job which would have taken sprayers three weeks, was performed in as many minutes!

Meanwhile the flyers had landed to find out the result of the test, and upon learning it they at once telephoned for a second plane with a photographer. The test was then repeated with equal success.

Mr. Dormey has designed a more efficient type of sifter and it is proposed to test the idea further as occasion permits. These tests will be watched with much interest by forestry experts, especially in the East, where a similar scourge is working havoc.

Gases in Metals

THE wide field and great practical importance of exact knowledge of the gas content of metals is brought to our attention more and more frequently. Aside from the more or less familiar importance of gases as related to the deoxidation of steel and the production of sound ingots and castings, many operations in refining, working, and treating of metals are vitally concerned with the action or effect of various gases.

Many of the inherent differences in quality of steels made by *different* processes are generally attributed to the amounts and compositions of the gases with which the metal is in contact when in the molten state in a converter, open hearth or electric furnace or in a crucible. It is reported that steel converters operating in a vacuum have recently been successfully used on a commercial scale in England to produce cutlery steel of unusually fine quality. The presence and nature of occluded gas in cast iron has been said to be *closely* connected with two important characteristics of such material, namely, the *graphitization of cast iron* and the growth of gray cast iron.

Of no less importance are dissolved or occluded gases in nonferrous metals. For example, the fire-refining of copper is wholly a matter of intentionally dissolving a gas (oxygen) in crude copper and then removing nearly but not quite all of this same gas. If the final step of this refining is carried to the complete removal of oxygen by poling only a minute or two longer than necessary, the whole furnace charge must be entirely reworked as if it were a fresh charge of crude copper.

In the working and fabrication of copper, gases must be again considered. Operations involving the cleansing of steel or iron by pickling in acids must be *followed* by treatments designed to remove hydrogen taken up *from the metals by the gases*. If not removed this occluded gas will make the metal too brittle to work or will give trouble in subsequent operations when the metal is exposed to heat, as, for instance, causing blisters in enamel. Occluded gases have also been shown to have a marked effect on the electrical conductivity of metals, their magnetic properties, their consistency in dimensions, as well as their mechanical properties of hardness, toughness, tensile strength, elasticity, etc.

Left Repairing the expedition's sled. *Right:* America's northernmost clubhouse, at Nome. The northernmost theatre is to be found in the vicinity

Two aspects of the (more or less) friendly Arctic

"The Friendly Arctic"

Its Well-Stocked Larder and How Three Men Lived Off the Country

WHILE yet a boy Vilhjalmur Stefansson decided he was a failure as a North Dakota farmer, so he went to college and became an anthropologist. All the world now knows him as an explorer and writer, and it is hard to say in which rôle he is at his best. His latest book, published by Macmillan, tells the story of five years in the polar regions. We owe the illustrations to the author

On his second Arctic expedition Stefansson discovered the blond Eskimo and added to the map of Canada perhaps these successes went to his head, for about this time he developed a startling idea This was no less fantastic a notion than that a man should be able to travel the most inaccessible and desolate stretches of the North unencumbered by food and fuel, living on the country as he went Incredible as it may seem, he managed to enlist the interest of both the American and the Canadian governments in his plan, and the latter eventually fitted out and financed for him what is known as the Canadian Arctic Expedition This included three ships and a scientific staff of fifteen men, the pick of the civilized world

Nome, Alaska, has the distinction of possessing the most northerly clubhouse, and the most northerly theater, in America The three ships left here late in July, 1913. A party left the "Karluk" and walked ashore on the ice to Cape Smythe, where the land was grass-covered and prairie-like, and birds twittered and mosquitoes buzzed, this was disappointing to Dr Mackay, of Antarctic experience, but he was promised blizzards and low temperatures later Soon after this the 'Karluk" was caught in the ice and, while Stefansson and a hunting party were ashore near the mouth of the Itkilik River, she disappeared with the supplies and photographic and scientific equipment aboard Passing quickly over difficulties and misfortunes that included a mutiny of the leaders against Stefansson's authority, we come to the time when, a month late, he and two companions, Storkerson and Andreason, started from Martin Point with one sled and six dogs for their journey into the unknown. They had full rations for the men for thirty days, and dog feed for about forty days, they had also two rifles and six gallons of kerosene for quick cooking on a blue-flame stove besides the hunting gear, the necessary bedding and the scientific equipment. Gales and ice-crushes enlivened the earlier stages of their journey, and the scarcity of game signs worried them During the first ten days of May, their kerosene was exhausted, and they went on half rations, for in their fast travel toward Banks Island there was no sight of a seal, it was at Banks Island that they expected to find the "Star"

Contrary to popular belief, the problem of drinking-water was non-existent. Sea ice becomes fresh during the period intervening between its formation and the end of the first summer following. Food and fuel were what they must have and when they paused long enough to make a conscientious search for signs of seal —they found them! A seal makes a breathing-hole by poking his head up through newly formed ice, and all he has to do then is to see that this hole is kept open. Months after the breathing hole has been abandoned, a distinct ring on the ice shows that seals have been there But Stefansson's party did more than find signs, they found the seals. From then on starvation no longer dogged their thoughts, and three men, "one crazy and two deluded," had vindicated their faith against the opinions of noted explorers and the convictions of the Eskimos. After ninety-three days on drifting ice, a journey of nearly 700 miles, the little party landed on June 25th, the chart showed the land as Banks Island, it was really uncharted land which Stefansson named Bernard Island, a mile or two from the mainland The summer was spent on Banks Island, by September 11th the party reached the Cape Kellett base, where they found the "Mary Sachs" instead of the "Star" Stefansson had long been given up for lost, and the excitement caused by his arrival was intense, he was told that the men on the doomed "Karluk" had safely made their way to Wrangel Island. Later, it was learned that many had been lost.

The winter of 1914–1915 was filled with busy preparations for the spring exploratory work Prince Patrick and Banks Islands were mapped, the most northerly point attained by McClintock was reached, and new land discovered beyond it, after which the party turned south and crossed Banks Island, reaching the Kellett base camp on August 9th Here Stefansson was, according to the newspapers, "rescued" by Captain Lane's "Polar Bear" The rescuers insisted on feeding him, though his only hunger was for news. It was then that he learned for the first time of the Great War that had been raging for a year

The following spring the expedition occupied itself with the Ringnes and Christian Island group, and found that the huge island known to mapmakers as King Christian's Land does not exist A small island, for which this name has been retained, is separated from the larger Findlay Island by a wide strait designated on Stefansson's corrected chart as MacLean Strait. Much good work was accomplished in this region.

This may be lonesome, but Stefansson did not find it unfriendly

In the five years that Stefansson spent in the Arctic, he mapped and explored more than 100,000 square miles of hitherto unknown territory, secured material of the greatest scientific value, and dispelled many illusions relating to Arctic conditions. Neither as explorer nor as anthropologist is he content to rest upon the obvious, which is so often the false. As to anthropology, his keen perception and careful deductions are well instanced in his handling of the "age of maturity" problem. The age of maturity, so authorities tell us, comes earliest in the tropics and increases as we traverse the temperate and frigid zones. Yet it is not rare for an Eskimo woman to have her first child at the age of twelve, here we have what seems a marked exception to the rule. Stefansson, however, remarks that the Eskimos unspoiled by civilization live a great part of their lives in a climate whose temperature is from 80 to 90 degrees Fahrenheit That is what a thermometer in one of their snow houses registers, and when they go into the open they are clad in two layers of fur that must maintain the body heat at a tropical point, in short, indoors or out, the Eskimo and the Sicilian live in the same climate. But our anthropologist does not rest here, he observes that the natives who have come under the influence of civilization, and who live in porous houses and dress in porous clothing, mature much later Among the northern Indian tribes, who live in wigwams and are poorly clothed, the age of maturity is quite as high as among the north European whites. Thus he accounts for the apparent exception to established theory

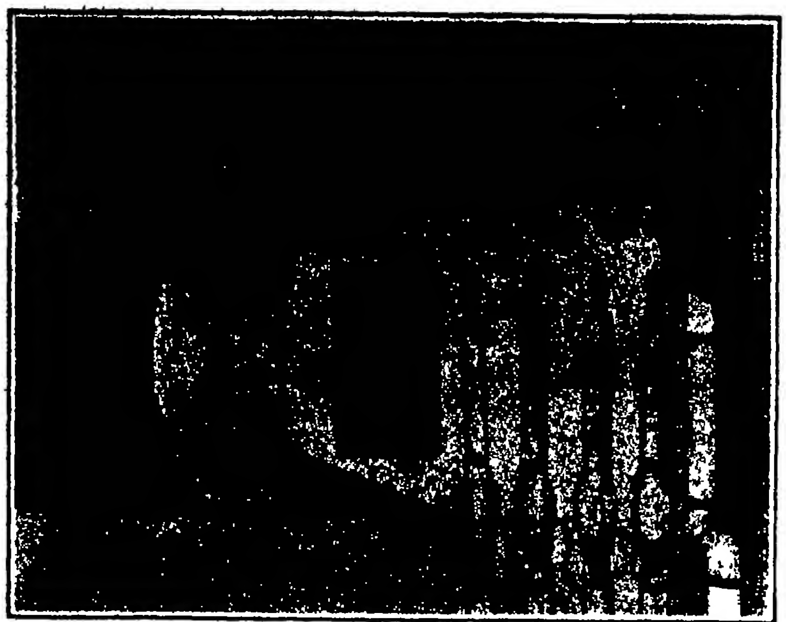
His visit to the Copper Eskimos near Phayre Point reveals the hospitality and child-like friendliness of these people, as well as their resentment toward being treated as inferiors. Stefansson himself was regarded as a magician, and was loved, respected, and a little feared. On his arrival at a village, the men at once built him a snow house on a site of his own selection. Trading was usually carried on in an atmosphere of high good humor, but when a subordinate of Stefansson's took an attitude of superiority, they robbed him of his goods. Later, these were either returned or paid for; but whether this was due to repentance or a wholesome fear that Stefansson, the magician, would send sickness upon them, is an open question. The Eskimo dislikes anything very hot, and more hot food is eaten in summer than in winter. The phonograph failed to interest them; it was just a miracle which they accepted as readily as any other miraculous happening, and they would drift into talk of the fleshpots while it was playing. Stefansson is insistent on the warm, well-nourished and happy life of the Eskimos, and, with one roguish eye cocked upon the missionaries, he remarks that, "It is one of the anomalies of our world that it should take the efforts of so many self-denying people to awaken the wretched to a consciousness of their wretchedness."

To Stefansson, going toward the polar pack is like going home, and he has other ideas about the north that are just as surprising. That impressive phrase, "the silent north," only arouses his laughter. The sum-

[illegible] days, he says, are full of the hum of bumblebees, the buzz of mosquitoes, the cries of plover, snipe and sandpiper, the squawk of ducks and many other noises, while the nights hold the demented screams of the loons. Near the sea, as ice is being piled against the coast, the cakes slide over one another with a high-pitched shrieking sound, followed by crashing as cakes as big as a church wall up-tilt to topple down in ruins. The buckling up and snapping of great floes adds a groaning "as of super-giants in torment." He objects to the word "desolate" also; all that he will concede is that trees are indeed not plentiful, and that there may be snow on the ground. But if you call that prospect "desolate" or "dismal," it is simply because your habits of life have accustomed you to trees and bare ground. Nor will he admit that Arctic exploration is a continuous round of hard ships; if you know how to hunt seals and to find your way by the patterns the prevailing winds fashion upon the ice, suffering can come only as it comes to all men, everywhere—by carelessness and by accident. He is convinced, too, that the "well-brought-up" young man makes the better explorer, since he finds him more adaptable to a strange environment. If you will conform to the ways of the north, he repeats, you will find it exceedingly friendly and homelike.

From these assurances the average reader will turn to the author's accounts of up-ended blocks of ice, their heads, fifty feet high, over-hanging the camp, of marauding polar bears, shot in the middle of their spring, and spattering the gunner with blood, of painful progress across the ice, vividly described as being a mean between wading and navigation, and of various other episodes not reassuring to the timid man. However, Stefansson is not claiming that the Arctic is friendly to the tenderfoot, and he certainly upsets many of our preconceived ideas of eternal silence, universal desolation, and continuous menace.

Stefansson, with his fresh viewpoints, carefully thought-out theories and unselfish courage has raised polar exploration from a cross between an art and a sport to something like a science. If the Challenger expedition discovered a new world at the bottom of the sea, the Canadian expedition found a well-stocked larder beneath the northern ice. His narrative so teems with virile life, suggestive observations and significant discoveries, that it is impossible to pick out even the high lights in a brief summary. Only the man who has read it can appreciate its epic quality, to him it brings the exaltation of wide, airy spaces, fresh-air humor of the most genuine quality, and accurate knowledge in place of a mass of misconceptions.



External view of heating and ventilating apparatus for the cow stable of a large dairy farm near New York

Heat and Ventilation for the Cow Stable

POWER-DRIVEN ventilation for the cows is the latest note in dairy farming. The installation we illustrate is from the establishment of one of the wealthiest of the "gentleman farmers" in the New York suburban territory, and we do not know whether in its present form it would pay its way on a dairy farm that had to meet its expenses out of its receipts, but it looks sufficiently plausible to lend the thought that it might.

The pipes carry steam into radiators which are located inside the big retort-like enclosure. Heat from these radiators is forced upward by a fan inside this big box, the motor at the left driving this fan. The heat passes up over the tile ceiling in the cow barn, where it is thrown out through air passages that resemble the ordinary registers of the conventional hot-air heating system. The force from the electric fan is sufficient to drive the heated air out of these and down over the cows, and it passes out through passages in the floor. This equipment renews the air in the entire building every four minutes. The idea, of course, is to get more and better milk and butter from the cows by making the animals comfortable and so far as it can be tested out on a farm which is not obliged to effect a commercial success, it seems to be a valid one.

Emergency Houses of Clay and Straw

THE housing problem, sufficiently acute in this country, is far more pressing in many sections of Europe. The difficulty here seems to be more a matter of general business conditions and bad practices in the building trades than anything else, in France and Germany it is rather the difficulty of securing proper materials that is interfering with the return to normal building. Accordingly, any means of substituting cheap and homely materials for the customary ones is of great significance to the European sufferer from the housing shortage—of far more significance than we in America, on casual thought, might imagine.

Both in France and in Germany means are being devised for cutting the Gordian knot along the lines suggested by this remark. Wooden framing must be had, of course, in its absence nothing worthy of any better name than hovel can be attempted. It is in the selection of materials for filling in the wall spaces that ingenuity is displayed. We illustrate a development in Germany where ordinary clay, either in the shape of bricks or as a built-up, integrated mass, is applied to the framework to make the walls, and at the same time we are reminded of a French system, largely parallel to this, under which the principal material is straw, usually in the form of crude brick but in some cases partly as filling between an outer and inner layer of this brick.

In both cases the framework may be made surprisingly light, in view of the relatively light weight of the finished structure contemplated. The foundation, though it must be adapted to the nature of the ground in which it stands, enjoys the same advantage as the framework. It is covered with sheets of tar paper to prevent dampness. The blocks of compressed straw, which in the French scheme fill the spaces in the wooden framework, are shaped like bricks, but are much larger than the ordinary brick. Their length in fact, corresponds to the distance between the uprights of the frame and their depth to the desired wall thickness. After the walls have been completely filled out with these crude blocks of straw, both sides of the wall are covered with a fine-meshed wire net, on which outer and inner coats of cement in the one case and the plaster in the other are laid. In spite of the thickness of the walls—15 inches or more—the ensemble turns out to be of surprisingly light weight.

The German method of using clay appears to be somewhat more flexible. Obviously the clay can be merely substituted for the straw in the above-described procedure. Other possibilities involve the construction of the entire wall in what amounts when finished to a single piece, either with the foundation offered by the wooden frame alone or with the further use of straw mats as suggested in one of our views. Then there is also the alternative of our second picture, where the framework is dispensed with entirely. The result here may be a hovel, as implied in a remark above but it would be a very sumptuous hovel, we have no doubt.

Emergency Money in Italy

THE scarcity of small change in Italy has reduced the population to using postage stamps instead. These, however, are not a success, for after passing from horny hand to horny hand foul pocket to foul pocket, they become even more black and greasy and germ laden than the two-penny halfpenny banknotes. And indelicate people are seizing the opportunity to palm off stamps that have already passed through the post. Ingenious tradesmen have accordingly combined advertisement with utility by issuing postage stamps in metal disks with a transparent front and the name of their wares on the reverse. Conditions illustrate the recklessness of the government, which deliberately neglects one of the easiest avenues of profit at a time when the national finances are in the shakiest condition.

Left: The finished framework as it stands before the clay is put on. Center: An alternative procedure for building the walls is to make them of clay bricks pressed closely together, instead of using a framework. Right: The finished clay house presents much the appearance of a brick dwelling

Clay houses that are being looked to for the solution of Germany's housing problem

Darts of Light

What Twentieth Century Physics Has Done to the Wave Theory of Classical Optics

By Dr. C E. Kenneth Mees of the Eastman Research Laboratory

THE nature of light has been the subject of famous controversy Newton in subduing under the weight of his authority the wave theory of Huyghens held that light consisted of discrete particles of matter shot off from the source which bombarded the objects on which they fell and were reflected to the eyes of the observer there producing the sensation of sight This explains reflection very easily and Newton was able with some difficulty to account for refraction too But what finally discredited the corpuscular theory was the phenomenon of interference (See SCIENTIFIC AMERICAN, July 19th, 1919 A Millionth of an Inch) If light is corpuscular it is difficult to see just how two streams of particles traveling in the same direction can possibly do other than reinforce one another

This difficulty led to the formulation of the wave theory, which accounts as well as the corpuscular one for reflection and refraction and better for interference and polarization Adopted at the beginning of the nineteenth century the wave theory of light has proved very fruitful especially after its mathematical investigation by Clerk Maxwell who showed that the waves could be treated as an electro-magnetic disturbance of the universal hypothetical 'ether' Recently however fresh phenomena have been observed which are difficult to explain under the classical wave theory, and it seems not unlikely that we may have to turn to a theory more or less analogous to the corpuscular one of Newton

The origin of light emission is now ascribed not to the molecules of matter or even to the atoms as a whole, but to the particles of negative electricity which are called electrons and which form a part of the structure of the atom The atoms of the chemical elements are held to consist of a nucleus carrying a positive charge of electricity surrounded by one or more electrons carrying a negative charge, the whole atom, of course being electrically neutral It is thought that these electrons revolve either about the positive nucleus itself or about some other center, and on their number and the corresponding charge on the positive nucleus depends the nature of the atom.

The electrons are supposed to revolve without radiating, but when an electron suffers some violent shock it gives up energy and this energy is radiated in the form of waves in the ether Thus, if an electron by the sudden impact of another electron for instance is thrown out of an atom and is attracted back to its place by the nucleus then, as it falls back it will send out a pulse of energy, and it will be seen at once that if light is produced by such a succession of shocks occurring to electrons, it is inherently probable that it will be radiated in pulses rather than continuously These pulses of energy have the very remarkable property that the frequency of the vibration emitted is exactly proportional to the energy which the electron releases The wave-length, of course, depends upon the frequency, the more waves there are in a given time the shorter their length must be since the velocity of light is constant So when an electron loses a very little energy, it gives out long waves, and when it loses a great deal of energy, it gives out very short waves

In an X ray tube the discharge of electricity is in the form of a stream of corpuscles traveling with a velocity which is very high and which depends upon the voltage of the electric current applied to the tube. When these corpuscles strike the target their energy is radiated in the form of X rays, and these partake very closely of the nature of light except that the length of the waves is about one-thousandth that of light or what is the same thing, the frequency is a thousand times as great It is to this that X-rays owe their great penetrating power

On the classical wave theory of light, then, we should imagine that an X ray tube having its target bombarded by the stream of corpuscles produced by the current would emit waves of X rays spreading into space just as waves of light are imagined to spread from a source But now comes a great difficulty When these X ray waves pass through a gas and are absorbed, they cause the molecules of the gas to emit electrons, and these electrons are emitted with almost exactly the same velocity as the electrons in the tube which produce the X rays themselves

The extraordinary nature of this phenomenon is well illustrated by Sir William Bragg He takes as an analogy the dropping of a log of wood into the sea from a height of 100 feet A wave radiates away from where it falls. If the water were perfectly free from viscosity, and there were no other causes to fritter away the energy of the waves, they would travel indefinitely, always diminishing in their height At some point say a thousand miles away, these now microscopic ripples encounter a wooden ship. We should expect that they would produce no effect, especially as they have passed many other ships without having affected them, but, for some reason as these tiny ripples reach the ship, a plank of the same weight as the log is hurled out of the ship to a height of exactly 100 feet, and the whole energy which was originally supplied by the log falling into the water is concentrated upon the ejection of this plank It will be seen at once how inadequate the wave theory is to account for this phenomenon

Very recently, new light has been thrown on this question of the radiation of light by the study of the exposure of photographic films The sensitive surface of a film, which is called the "emulsion," consists of microscopic, crystalline grains of varied sizes, ranging from those which are visible only as specks under the highest powers of the microscope to crystals which are easily visible and show clearly defined forms. When these grains are exposed to light they become developable after they have received sufficient exposure, and under a wave theory of light the difficulty has been to see how they added up the light until they had enough. Imagine a film exposed under a telescope to the image of a star At the end of five minutes' exposure, no grains at all might be developable, and no image of the star would be obtained Nevertheless, some change has occurred to the grains if we accept the idea that they have been continuously exposed to light, because if we go on exposing presently some of the grains will be developable and after hours of exposure enough grains will be developable to make a good image of the star Moreover, the grain stores these impulses with such security that if the exposure is interrupted for weeks and then started again, the grain will not have lost its record of the former exposure but will start practically where it left off

FOR a decade or more it has been increasingly plain that something was happening to the classical wave theory of light, and if the relativity postulates of Einstein stand the test of time, this fact will be as evident to the layman as to the physicist We ourselves have had numerous inquiries asking what theory of light propagation will be in harmony with universal relativity To these queries we have replied in a general way that we do not yet know, but that it will evidently be something in the nature of a compromise between a wave theory and a corpuscular one That science is actually moving in this direction, and is making some progress, is indicated by Dr Mees in this account of the work being done by Dr Silberstein —THE EDITOR.

Another difficulty which arises when we study the exposure of the individual grains is that they appear to differ in sensitiveness, the bigger grains are very much more sensitive than the smaller Moreover, if we sort out a number of grains, all of the same size and shape under the microscope, they will not all become exposed at the same time, some of them will become developable before others, and if we imagine that they have all been exposed to a uniform flow of light, we must consider that these grains differ in sensitiveness among themselves.

If we had no prior knowledge of the wave theory of light, it is clear that the simplest explanation of the different sensitiveness of different grains would be that instead of a continuous flow of light in the form of waves on to the sensitive film, the light was falling upon it as a rain of projectiles, and that these projectiles, made developable any grains that they hit, the grains which were missed not being developable but being hit later if they continued to be exposed to the radiation Now, this assumption was made by Dr. Ludwik Silberstein, who is studying the problem in the Eastman Research Laboratory, and he was able to calculate the chance that a grain of any size would be hit by such a projectile and would therefore become developable. Naturally, the bigger the grains the more likely are they to be hit, so that a calculation can be made of the relation between the size and the number of grains which will become developable after a given exposure. When the experiment was tried, it was found that the bigger grains become developable more quickly, as compared with the smaller grains, than they should have done according to the calculation. It is possible to explain this discrepancy by several modifications of the simple idea The first which Dr Silberstein has suggested is that the projectiles are not infinitely small, but have an appreciable diameter varying over a wide range but of an average size comparable with that of a very small grain If we make this assumption, then, from the rate at which the grains of different sizes become developable, we can calculate the average diameter of the projectiles of light, and this has been done

Whatever the projectile of light is, it must be associated in some way with waves, because, as was said earlier the frequency of the vibration emitted is proportional to the energy of the electron which produced it, and so, while we have gone back to a projectile theory of light, instead of the idea of a continuous wave front, we have not abandoned waves. Dr Silberstein suggests that the projectiles rather than being called "corpuscles," which gives the idea that they are round, should be called "light darts" and should be imagined to consist of a long train of waves of very small diameter traveling, of course, with the velocity of light.

This theory, then is that the electron when it suffers a shock transmits its energy to the medium (whatever that may be) in which light travels, in the form of a train of waves of small section and of considerable length, traveling with the velocity of light Naturally, many questions come to our mind, and the idea is too new for it to be possible to answer all of them at once. Some of them can be dealt with experimentally, some mathematically some will have to wait for new facts and new methods of attack As soon as the photographic measurements can be made it will be possible to determine whether the darts of X rays, for instance, give the same results for their average diameter as darts of visible light This will settle the question as to whether the darts vary in diameter with the frequency The problems presented by interference and diffraction can be dealt with mathematically All that we can say at present is that it is not impossible that these phenomena may be explained on the hypothesis that light consists of these separate trains containing many waves of light The method by which an electron emits a light-dart and the relation between its energy and the frequency of the radiation emitted will require very much more work. A guess is that possibly the law of emission is that the radiation is emitted for a definite time whatever the energy to be communicated, and that consequently the frequency has to be proportional to the energy in order that different amounts of energy may be radiated in the same time. Since the amount of energy in a light-dart is very small, light of ordinary intensities contains enormous quantities of them, and it is only in a few cases that any distinction could be detected in the effects produced upon matter between a continuous radiation of energy in the form of waves as demanded by the older theory and a rain of projectiles such as is now suggested. A rain of arrows, for instance, if sufficiently closely packed would have just the same effect upon a material as hitting it with something solid, and in the same way we should expect that the classical wave theory would hold except where we might have methods of exposing individual particles to radiation and observing what happened to them.

This theory is, of course, quite new, and there are many difficulties which it will have to meet, but if we had no classical wave theory of light and were considering only the facts known to us, it is not impossible that the difficulties presented to the ordinary wave theory by the photo-electric effect, the absorption of X-rays, and the theory of photographic exposure would appear less formidable than those which the problems of interference and diffraction present to the light-dart theory. Fortunately, the theory leads to a great many experiments, and it will probably be possible to come to definite conclusions as to its value as soon as the many experiments which are indicated can be carried out.

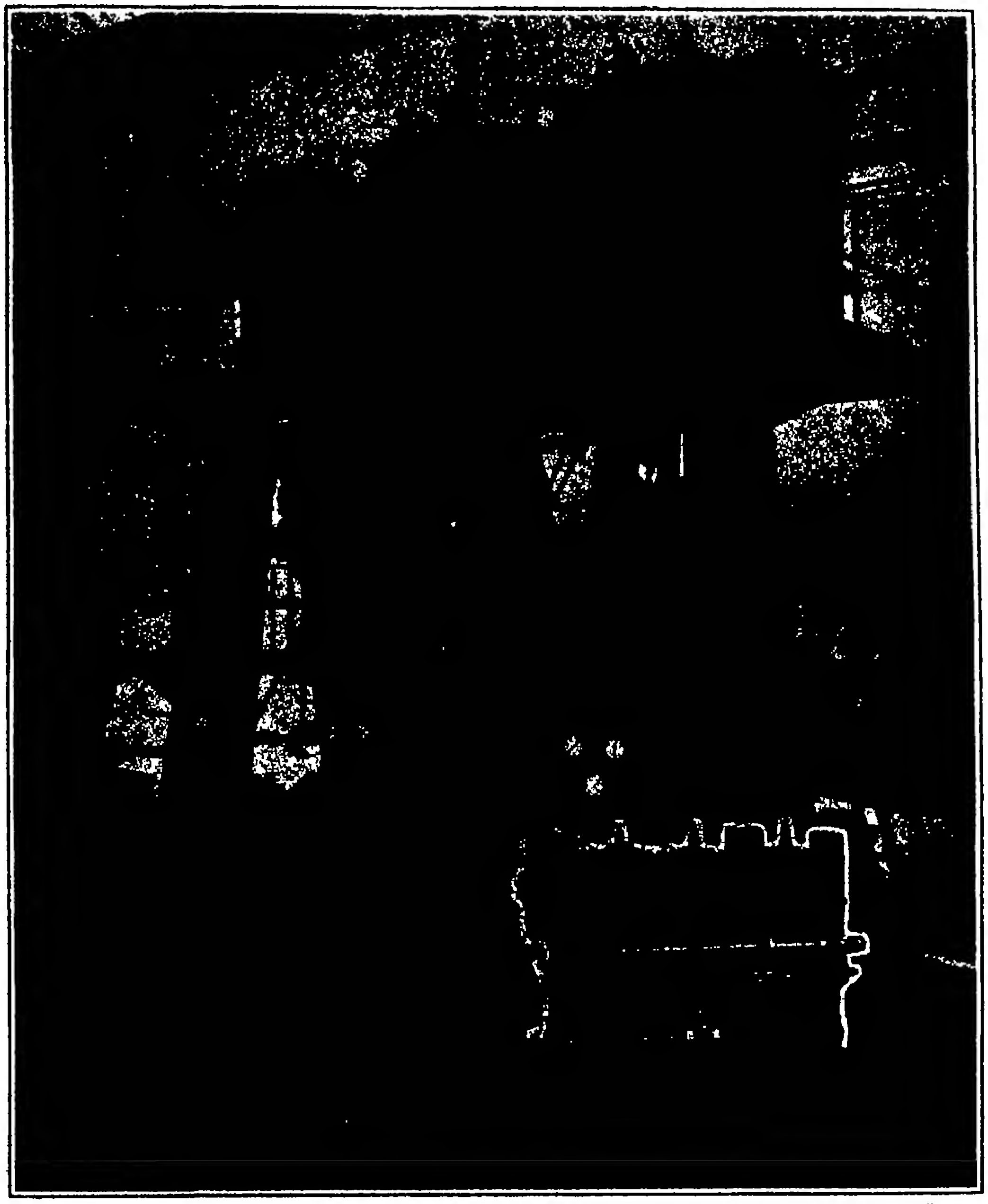
Speed as a Factor of Horsepower

IF one were asked to name the element in a steam engine which has contributed more than any other to its increase in power and efficiency, he would not be far wrong if he named that of speed—speed of revolution The early steam engines, such for instance, as the great, single-cylinder pumping engines of over 100 years ago, were very slow moving machines. So were the early stationary engines. Steam pressures were low, running from, say, 10 to 25 pounds to the square inch, and to secure the desired total pressure on the piston it was necessary to make its diameter inordinately large But in spite of the large piston area, the total thrust of the crank pin was moderate, and in order to get a large turning movement, the crank pin had to be made of great length, hence, cylinder diameters were measured in feet, and would run up to as much as seven feet. The stroke was in proportion. Even as late as the middle of the nineteenth century we find the Great Eastern with oscillating paddle engines, whose cylinders were over 6 feet in diameter by 14 feet stroke, while the cylinders of her propeller engines were no less than 7 feet in diameter

As the art of engine building progressed, and the manufacturer was able to supply better qualities of steel, engineers began to aim at getting power more through the speed of the engine than through its large dimensions. This development progressed until power users were able to secure small, compact steam engines, occupying merely a fraction of the space, and weight, to say nothing of the cost, of the heavy and cumbersome engines of the same horsepower output

The conditions confronting the naval engineer, under which it was desirable to keep the whole of the motive power below the protective deck—and therefore below the waterline—proved to be a great stimulus to engineers in their effort to cut down the bulk and weight of modern engines, and it was here that great progress was made, cylinder diameters being reduced steam pressures increased and the speed of revolution raised.

This was notably the case when the torpedo boat, with its demand for a combination of small size and high speed, made its appearance, and it was in the torpedo boat destroyers that the high speed, high power, steam engine reached the peak of its performance In these little engines the very finest materials and workmanship were incorporated, and the speed of revolution run up to several hundreds per minute. The striking photograph which is herewith shown represents, in telling fashion, the effect of high speed in reducing dimensions. Both of these engines were built in the shops of the Yarrow Company The larger of them, a slow-speed pumping engine, is 21 feet 9 inches in length by 14 feet 8 inches in breadth, and 22 feet 10 inches in height; the other, a high-speed destroyer engine, is 6 feet 9 inches in length by 2 feet 6 inches in breadth, and 4 feet 9 inches in height. The total horsepower of these two engines, in spite of the great difference in dimensions, is the same



The pumping engine measures 21′ 9″ x 14′ 8″ x 22′ 10″ in height. The torpedo-boat engine is 6′ 9″ x 2′ 6″ x 4′ 9″

The massive slow-moving pumping engine and the diminutive torpedo-boat engine are of the same horsepower

Modern Stone Age Men

OVER a vast region in the arid interior of Australia the inhabitants are still in the age of stone. And an effort is being made to keep them there. Through the joint action of the Commonwealth (as the owner of the Northern Territory) and of the States of West Australia and South Australia an area of 65,000 square miles has been set apart as a sanctuary for the native fauna (including the genus homo) and flora This reserve is the largest of its kind in the world It has an area almost equal to that of the State of Missouri (69 415 square miles) or of Washington (69,180 square miles) Much of it is practically unexplored The very few exploring parties which have entered it have usually traversed it in haste, owing to the difficulties in obtaining water and to fears of the attack by the natives.

Many of the aborigines in this region have never seen a white man They still fashion their rude weapons and implements of wood and stone, and are entirely ignorant of the use of metal Of their numbers little is known, but it is estimated that they do not amount to more than 2000 or so At Charlotte Waters the nearest point at which records have been kept, the rain fall averages only 3½ inches a year

Cannibalism is still in full force among the wild natives of the Everard Ranges In order to obtain food the aborigines have to be constantly on the march When the old folk can no longer keep up with the tribe men secretly told off for the purpose creep up behind them and knock them on the head In order to avoid waste they are then cooked and eaten

Captain S A White, one of the very few white men who have ever entered the reserve, found that while the natives knew nothing of the art of smoking, they were much given to chewing the leaves of an indigenous species of tobacco which grows wild in the Everard Ranges. This is a new species, somewhat closely related to the tobacco of commerce and has been given the name of nicotiana suaveolens excelsior

It is proposed to allow the natives within the reserved area to go on living in the Stone Age No white men except a few specially guaranteed scientists are to be allowed to enter the sanctuary In particular no missionaries are to be let pass within the pale

Over most of the rest of Australia the aborigines have vanished or are steadily disappearing The Tasmanian race a distinct variety of man has been extinct for 45 years In Victoria (90 000 square miles) there remain about 500 "natives" of whom however only a dozen or so are of pure blood In New South Wales (325 000 square miles) there are fewer than 4000, including half castes Over the greater part of South Australia Queensland Western Australia and the Northern Territory the aborigines are steadily melting away

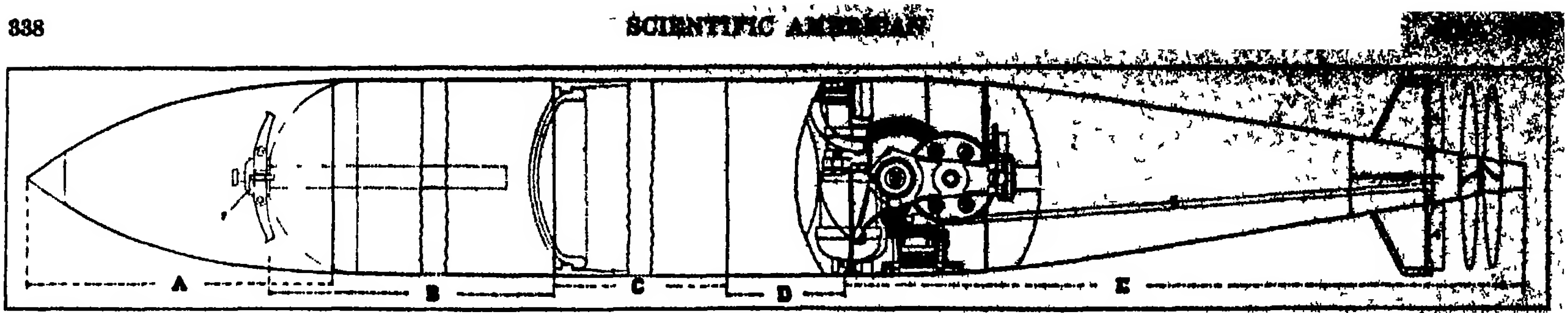
It is hoped that in this reserve in the far interior a remnant of the race may be preserved untouched and uninfluenced by the white man s civilization

Effective Methods of Liming

TO be effective, lime should be as thoroughly mixed as possible with the plowed portion of the soil This is usually most economically done by broadcasting lime on newly plowed land and mixing it with the soil by the disking and harrowing necessary to prepare the seed bed Most of us advise against plowing lime down In theory a portion of the lime application might be made before plowing and disked into the soil and the remainder applied after plowing as above suggested. There is no evidence, however showing that this would be economical The time of application or the season of the year is immaterial and in farm practice it will often be determined by the distribution of farm labor The place in the crop rotation should be just preceding the crop most responsive to lime providing it is convenient to apply at that time and the preparation of the land will provide for proper mixing of the lime with the soil Where this is not possible it may be applied for a crop earlier in the crop rotation

While top dressing with lime is not generally advised it may be justified on land already seeded to clover, especially when the success of the clover will be largely determined by the lime For top dressing finely pulverized limestone may be better than freshly burned lime in spite of frequent statements to the contrary Freshly burned lime used as a top dressing is subject to puddling in which case the lime will cake and remain on the surface for a long time after being deposited

The old method of spreading lime from small piles distributed over the field by means of shovels is not to be recommended Such distribution is too uneven to expect the best returns from it Nothing is better for spreading lime than a lime spreader made for the purpose One which will provide for a wide range in the rate of application will not clog and will spread uniformly is to be recommended The lime should be so placed in the field that it will be accessible to the lime spreader and provide for the minimum amount of handling of the lime — *Abstract from the article by F D Gardner in the Journal of the American Society of Agronomy for May, 1921*



Section A, hollow collapsible speed cap Section B, explosive charge compartment. Section C, compressed air container. Section D, fuel and water compartment. Section E, afterbody containing 500 h p gyroturbine power plant, as shown in section broken away, and the hydrostatic mechanism for controlling the depth of navigation

Fig. I New 21-inch gyroturbine with radius of 5000 yards at 50 knots

A Fifty-Knot Torpedo

AN ingenious application of the gyroscopic method for steering torpedoes invented about 1884 by Captain John A Howell, an American naval officer, has recently been introduced in a high powered turbine-driven airplane torpedo designed by Mr H W Shonnard of Montclair, N J, who for several years was associated with the development of the well known Bliss-Leavitt torpedo, now the standard weapon of its kind of the American Navy

Until Howell proposed the utilization of the gyroscopic force created by a spinning mass, and adapted such to practice by constructing a small torpedo fitted with a heavy fly-wheel having its axis in the horizontal plane athwartship, which fly wheel when spun to a high rate of speed served the double purpose of furnishing gyroscopic force and also energy for propulsion, no reliable self-controlling means for steering torpedoes had been developed

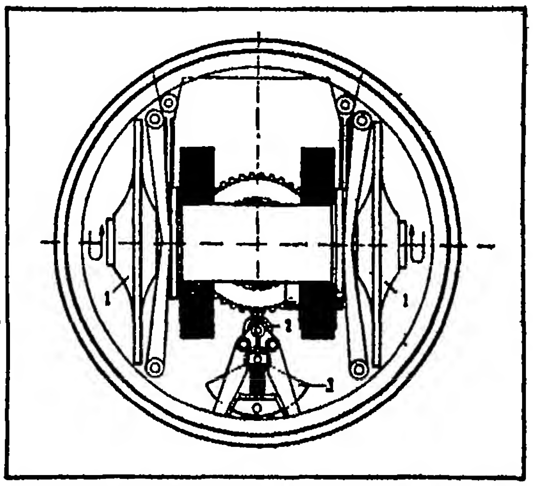
Under the plan devised by Howell, a lateral extraneous force that might tend to deflect the torpedo from its course, would cause the torpedo, through the gyroscopic action of the rotating fly wheel, to roll slightly to port or starboard, according to the direction of said force, and bring into action a pendulum-controlled ratchet mechanism which operated a pair of vertical rudders. This means of steering was very effective and reliable About 1888 the Whitehead Torpedo Works succeeded in applying a gyroscopic principle for steering in the form of a miniature removable unit, known, after its inventor, as the Obry steering gear This device gave such control.

Throughout the subsequent evolution of the torpedo the excellent principle evolved by Howell has for many years apparently escaped the attention of inventors and engineers.

In the Howell method the elemental basis of control originates in the gyroscopic force of the torpedo's motive means, which, it will be remembered, was a heavy fly-wheel in which necessity for delicate adjustment of the mechanism is eliminated, since any tendency of the torpedo to leave its course as a result of extraneous influence is automatically suppressed. On the other hand, in mechanism of the Obry type no automatic suppression or correction of gyroscopic precession is possible, the course of the torpedo being entirely dependent upon a miniature, delicately-mounted gyro-wheel remaining in the plane of rotation established at the time of launching the torpedo Should it precess, and it usually does, and often to a considerable extent, proportionate deflection in the torpedo's course results.

Continual advancement in the speed and range of torpedoes and the height from which it becomes desirable to launch them, now that the airplane is available for the purpose calls for gyroscopic mechanism of a rugged nature that is capable of continuous and closer control than is characteristic of Obry gear The solution of these requirements is to be found in the method of Howell, and the designer has accordingly applied the same to his turbine-driven torpedo in the manner illustrated.

In Fig 1 is shown the general arrangement of the Shonnard 50-knot airplane torpedo, wherein turbine rotors create the gyroscopic force necessary for steering under the Howell system. By referring to Fig. 2, which is a view of the turbine compartment looking aft, it will be noted that the two turbine rotors 1, 1, of the DeLaval type, which are geared to revolve at 22,000 revolutions per minute in like direction as is indicated by arrows, are mounted upon horizontal axes, one each side of the major, or longitudinal, axis of the torpedo, and a servo-motor, or air engine 2, controlled by a pendulum 3, is located below the turbine This pendulum unit which is connected with the vertical rudders 4, 4, by the rod 5, Fig 1, operates said rudders in response to the gyroscopic action of the turbine rotors, exactly as the pendulum arrangement of Howell operated rudders in response to the gyroscopic action of a fly-wheel.



1, 1, The two 250 h.p. turbines. 2, The servo-motor, controlled by 3, the pendulum, to regulate the depth of the torpedo

Fig. II. Cross section at the gyroturbine power plant

The motive energy used to operate the turbines is superheated steam in combination with the products of combustion of alcohol burned in compressed air, which mixture enters the turbine nozzles at a pressure of 500 pounds per square inch and at a temperature of 1500 degrees Fahrenheit.

In combining the steering and motive elements in a single unit, a further advantage is secured in the saving of weight due to the elimination of the Obry gear mechanism, which effects sufficient change in moment to permit of the installation of a power plant capable of developing 500 horsepower without disturbing the normal horizontal trim of the torpedo. In view of the probable limitation of warship construction, Mr. Shonnard's proposal becomes of particular interest, since it presages a notable advance in airplane torpedoing for coast defense.

Measurement of Leather Skins

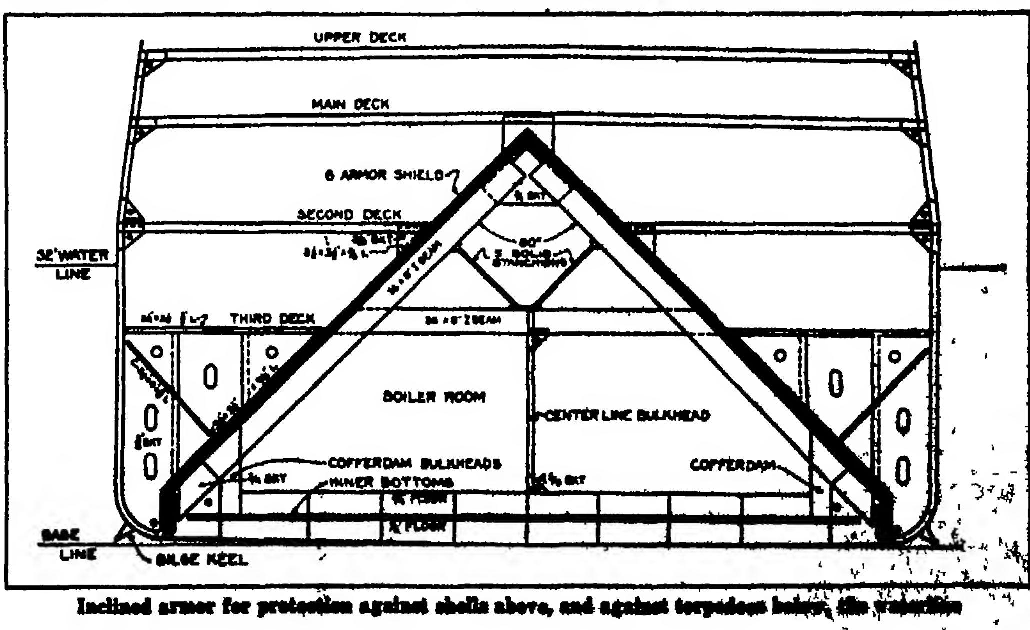
SKINS from which leather of various kinds is made are purchased on the basis of area, and the method used in determining this area has been the subject of careful investigation in the past by the Bureau of Standards. Recently a rather interesting case came up in which the Bureau was called upon to act as an umpire to decide whether certain skins were correctly measured. Some American dealers submitted 48 glazed kid skins of which 24 were said to be of domestic origin and 24 from foreign sources. The dealers believed that there was an inconsistency in the measurements of the foreign skins as compared with the domestic. After determining the areas with great care, the conclusion reached by the Bureau was that the domestic skins were over-measured approximately 1¼ per cent, a comparatively insignificant amount, while the imported skins were found to be overmeasured between 9 and 10 per cent. An error as large as this is regarded as important, and as the skins are paid for on the basis of area, it means that too much is being paid for the foreign skins. If the samples submitted were representative of the conditions existing in the trade, the whole matter should be carefully looked into.

Internal Diagonal Armor for Warships

THE diagram accompanying this article, which shows the cross-section of a battleship, represents, by the two heavy black lines, a suggestion by one of our shipyard workers, Mr C. H. Scheelky, for a method of armoring warships to meet attack by modern high-angle fire, by aerial bombs and by torpedoes.

In spite of its striking novelty and certain difficulties of interference with boiler and engine-room accommodations, the general idea is so much in keeping with the latest theories of warship armoring that we present it for consideration. The armor plan of ships built prior to the war calls for very heavy vertical armor, supplemented by light deck or horizontal armor. That was in the days when 10,000 yards was considered an extreme fighting range, and when shells fell upon a ship at an angle of 6 to 8 degrees. Today, the fighting will be at the extreme practical range, and the angle of fall will be from 18 to 25 degrees; which means that the greater part of the deck will be opened to direct attack. Hence the growth in favor of internal inclined armor.

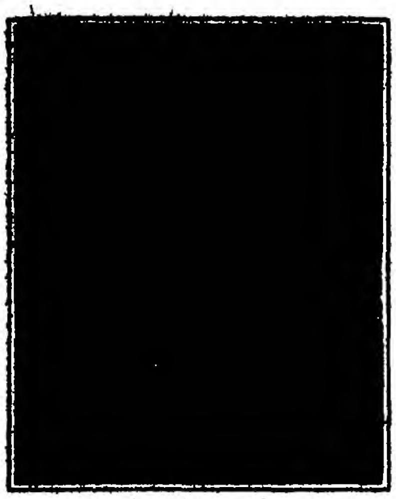
The interesting point about the proposed method is that the design shows no vertical armor, and that the inclined armor is carried right down to the bilges. In answer to our question as to why this was done, Mr. Scheelky [illegible]



Inclined armor for protection against shells above, and against torpedoes below, the waterline

Inventions New and Interesting

A Department Devoted to Pioneer Work in the Various Arts and to Patent News



Cotter puller that works like an inverted hammer

Another Cotter Puller

THE cotter-pin extractor which we illustrate is different from the majority of such tools, in that it does not attempt to provide an actual leverage against the recalcitrant pin. A hook on its small end engages the loop of the cotter. Of the two handles that appear in the photograph, the upper is fixed and the lower slides. The sliding one is then moved up and down on the rod striking sharp blows upon the under side of the fixed handle. The effect of this hammer action is to drive the cotter out of its seat. Conditions are easily imaginable under which this would be about the only tool that could deal with an inaccessible pin. It will also pull axle-shaft roller-bearings, and will straighten radiator fins and tubes.

Short Cuts for the Draftsman

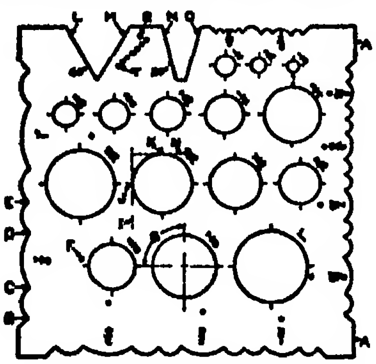
STENCILS of one sort or another for the use of the draftsman are not exactly a new story, but the pictures which we present herewith make it clear enough that this useful idea has not been by any means pushed to the point of exhaustion. The apparatus which appears in the diagram of our second column is a sort of general utility tool. It is accompanied by a little circular that gives complete instructions for the drawing with its aid of circumferences from ⅛ to 9 ⁷/₁₆ inches, U. S. standard screw nuts from ¹/₈ to 1 inch, screw threads of 60-degree angle and acme threads of 29-degree angle, lettering of 14½ and of 80 degrees inclination. Its very general utility contrasts interestingly with the very special field which is covered by the stencil that appears in our first column. This is designed to aid the draftsman who is called upon to produce a large number of chemical drawings with their conventional representations of the various laboratory apparatus. It seems clear enough that he would not have to do much work of this sort to save the price of the instrument. Who will now put out a similar tool for the standard circuits and other symbols of electrical drafting?

Stencil for the draftsman who is working in chemistry

Clever Automatic Chain-Welding Machine

A CLEVER machine for automatically welding chain is described in the *Berliner Tageblatt*. Compared with flame and autogenous welding electric welding has the great advantage of making an entirely homogeneous joint because dirt and oxidation have no effect and also because any uncertainty connected with handwork is avoided.

These advantages are particularly noticeable with special machines, such as the automatic chain welding machine of the Wenniger Works in Munich. It has taken several years to develop this machine as there were many difficulties to be overcome. The greatest difficulty was the designing of suitable mechanism for altering the velocity of travel of the chain for varying thicknesses of wire to be welded. The chain is fed in through guide-rails, and is moved forward by means of clamps in such a way that a joint always lies under the electrodes of the transformer. The primary current is switched on and the secondary heats up the ends to welding heat in a very few seconds. At the same time the link is gripped from both sides and the ends lightly pressed together so that the diameter at the joint is increased. This pressure cuts off the current and sets in motion the mechanism for pushing the chain forward. The chain is moved forward one link, and the joint of the link just welded is smoothed down. About ten links are welded per minute.



A general utility tool for the draftsman that saves much time

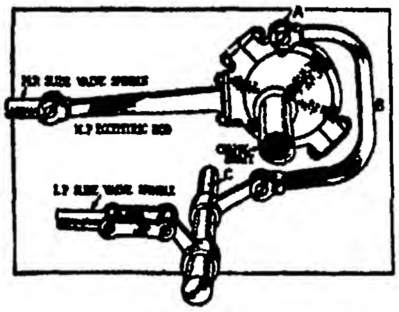
New Air Purifier

A SANITARY novelty has been placed on the market recently that purifies the air wherever it is placed. Within the enameled, perforated box a block of specially treated paraffine is placed. The perforated section slides off permitting new blocks to be placed inside as evaporation takes place. One block will last four weeks, but must not be placed in any direct draft.

Handy air purifier that hangs on the wall

A British Steam Truck

DESCRIPTION of a steam truck of British manufacture unusual in some respects has recently appeared in *Motor Transport*. The boiler is of a type which has about double the heating surface usual in steam wagons. It is of a type too in which the smokebox doors at each end are utilized as chambers for the exhaust steam, which thence through small nozzles escapes along the upper tubes of the central combustion chamber at the base of the chimney. In the present design each smokebox door has six exhaust nozzles discharging through a single row of large tubes. Incidentally each exhaust pipe is formed with a trap for condensation. By disposing of the exhaust steam on this method it is obvious that a steadier and gentler draught is possible; consequently the type affords an easy steamer requiring little or no forcing, pulls its fire about but little, while in no other is the water level less affected on steep gradients; the fusible plug can be fixed 8 inches to 9 inches below the water line, and so the risk of ruining one is very remote.



Arrangement of high and low pressure units in new steam truck

The engine motion is such that the D slide-valves of both high and low pressure cylinders in both forward and reverse directions are operated off a single eccentric. The principle of this motion is as follows: The cranks of the two cylinders are at right angles to each other. The eccentric works the high pressure valve direct and at a point 90 degrees further round (to correspond with the position of the low pressure crank) the eccentric strap carries a lug A, whence a link B transmits this motion to a rocker shaft C, off which the low pressure valve is actuated. The whole arrangement is best seen in the sketch on this page. Incidentally this is the only undertype steam wagon employing a compound engine.

Steam in Four Minutes

RECENT developments in steam generation include application of the principle used in the well known coffee percolator, where a small quantity of water is heated at one time. Externally the new boiler has an appearance similar to the ordinary house-heating boiler but the interior construction is quite different. Immediately above the fire, which may be wood, coal, gas, oil or any form of fuel, is located a cast iron spider which contains less than a gallon of water. This spider is fed with water from the water jacket through six cast iron legs. The water supply, instead of being contained in the boiler immediately above the fire as in other boilers, is contained in an equalizing water column at the side of the boiler and feeds from this water column into the water jacket and then into the spider as it is needed to replenish the water taken out of the spider and converted into steam.

Water entering the heater travels upward from the bottom through the water jacket absorbing heat as it does so, and flows through the hollow arms to the center of the spider, which is located in the hottest part of the combustion chamber. At this point the water is partially converted into steam, the expansion shoots water and steam up through the vertical geyser tube into the top steam chamber, where it is immediately converted into steam. A series of concentric upward projections keeps the water distributed in a thin film over the heating surfaces. Water not evaporated in this top steam-chamber flows through nipples on to the bottom plate of the lower steam-chamber. This plate is also part

House heating boiler that works like a coffee percolator

The illuminated glove for traffic signalling

of the heating surface and is provided with upward projections which distribute the water uniformly. Any water still unevaporated here flows through a cored passage and downward through piping into the general circulation.

The whole apparatus consists of simple castings and pipe fittings so put together that complete or partial disassembling for access to any interior part takes but little time.

Laboratory tests taken at the Carnegie Laboratory at Stevens Institute give the boiler an efficiency rating of 75.89 per cent, which is about double the efficiency of the ordinary house-heating boiler. In this test the time from the lighting of the fire to one pound pressure by the gage was four minutes and to nine pounds pressure was seven minutes. The temperature of the water in the boiler at the start was 73 degrees Fahrenheit at the bottom. At the end of seven minutes with nine pounds pressure of steam by the gage the temperature of the water in the boiler at its base had reached only 80 degrees. This shows that steam is generated practically from the time that the fire is lighted and without the necessity of heating the entire body of water to the temperature of the steam.

Conveyor Belts of Steel

WHEN we in this country think of conveyor belts we naturally picture to ourselves one of leather, rubber or some specially prepared fabric, for we have been accustomed to seeing and using belts of this description. Abroad, however, flexible steel conveying belts have been used with success for some time. They are made from Swedish charcoal steel with a carbon percentage of about 0.65, cold rolled, hardened and tempered by a special process by a certain steel works at Sandviken, Sweden. This works has a controlling interest in a very large number of the world famous Swedish mines that produce iron ores low in sulfur and phosphorous.

The steel belt conveyor is said to be especially suited to conveying warm, sticky, sharp or abrasive material which rubber and fabric belts do not handle with satisfaction. It is also said to be lower in maintenance cost than apron conveyors and wire woven belts, to consume less power and to eliminate spilling. In the sugar pulp and lumber industries all over Scandinavia where these steel belts have been in extensive use they are running in the open air subjected to rain, snow and sunshine and are said to work exceptionally well. A coating of rust appears when the belt is idle, but a thin film forms that protects the steel from further injury, and the rust itself does not penetrate.

The police "tear bomb"

Glove with Signal Light

ON the back of this slip-over glove for motorists is a flashlight operated by a small storage battery seen in the case. By pressing button with thumb a driver can give a red flashlight signal when using his hand for signaling. It is used at night only. Made to fit either hand.

A New Radioactive Mineral

AT a meeting of the French Academy which took place December 5th, 1921, a report was read by M. Alfred Schoep describing a new mineral from the Belgian Congo to which he proposes to give the name of Curite in honor of the late Professor Curie, because of its radioactive character. This mineral is soluble in nitric acid even in the cold, the solution being yellow. It is readily dissolved by warm hydrochloric acid.

Curite is found in three forms: (1) As translucent reddish brown needle-like crystals; (2) as compact saccharoid crystalline aggregates of an orange color; (3) in the form of orange-colored earthy masses surrounding the preceding variety. The chemical composition is expressed by the formula $2PbO\ 5UO^3\ 4H^2O$.

This 24 inch roll contains 285 feet of flexible steel belting

The Police Tear-Bomb

MUCH has appeared in the daily press about the use by our police of tear bombs in the effort to control the outbreak of crimes of violence from which we are right now suffering. The illustration herewith shows how one of these bombs works and will strike a familiar chord in the minds of those who went through actual service in the war. When the pin between the upper and lower sections of this queer bottle is pulled out the liquid in the small tube above will flow at the slightest shock out of this tube and into the bell shaped body below. This shock of course comes with the throwing or in any event with the striking of the bomb, and a reaction is at once set up which releases a large volume of a gas that makes the immediate neighborhood highly uncomfortable for human habitation while doing no slightest permanent harm to its victims. This particular version of the gas bomb is the invention of Major S. J. Delanoy of Trenton, N. J.

The Expansion of Metals

SCIENTIFIC Papers of the Bureau of Standards No. 426, entitled, "Thermal Expansion of Nickel, Monel Metal, Stellite, Stainless Steel, and Aluminum," gives data on the thermal expansion of 29 samples of commercial nickel, monel metal, stellite, stainless steel and aluminum and results obtained by previous observers on the expansion of nickel and aluminum. The results are presented in the form of tables and curves. For example, the expansion curves of stellite show irregularities in the region between 300 and 500° C. However, for commercial nickel only a slight irregularity was perceptible at about 350° C. For the range from room temperature to 100° C the coefficients of expansion vary from 0.000006 for a sample of hardened stainless steel to 0.0000230 for a sample of exceptionally pure aluminum. This publication is now ready for distribution and anyone interested may obtain a copy by addressing a request to the Bureau.

The disking saw that makes joints in wooden members

Wood Joints by Machine

THE roughing out and finishing of an accurate joint between two wooden members is one of the carpenter's most tedious tasks. One J. W. Hobbs of London has now taken this job out of the category of hand work. The machine which we illustrate consists of a clever arrangement of circular saws which slots the pieces to be jointed and makes keys for these slots in the form of thin wooden disks. The machine it is claimed will make a perfect joint in any wood and at any angle in eighteen seconds against an average of half an hour or more for the same work done with hand saw and chisel.

A New Autographic Camera Attachment

AUTOGRAPHIC cameras have been in use long enough for their advantages to have become thoroughly familiar to all. Mr. W. A. Brown of Rochester, N. Y., dissatisfied with the way in which his machine worked, however, decided that while the autographic feature was fine on general principles he could improve upon the usual means of achieving the result. We illustrate his new apparatus on which a patent has recently been issued to him.

Mr. Brown's idea involves writing directly on the film instead of through a piece of light proof paper, and it makes it possible also for the writer to see better what he is writing. He employs an adaptation of the familiar pantograph principle. The operator writes with an ordinary pencil on an ordinary pad of paper attached to the outside of the camera, and the text is reproduced by a second pencil, inside the camera, driven by the one held in the hand. The two pencils are connected by a sliding rod that pierces the side of the camera via a light-proof sliding shutter. Pressure on the outside pencil rocks the inside one up against the surface of the film. When the outside pencil is swung around and laid away in its socket, the inner pencil is similarly rocked around and laid down at the side of the box, out of the range of the exposure. Spring pressure on the inside pencil takes care of any lack of uniformity between the surfaces of pad and film.

The camera with the back removed to show how the outside pencil drives the inner one

For the Film Editor

INSPECTION of motion-picture films in the process of editing a play, etc., is a rather time-consuming task. The director or editor has to leave his desk and journey to the projecting room and he has to communicate his desires for stops, starts and re-runs to the operator, who may or may not get them the first time. A clever little apparatus has just been put out by M. Charcot, a well-known French theatrical man, which greatly simplifies this work of inspection, especially of short strips of film.

The reel with the intermittent control is the usual one of the cinema world, so that the film is run off in the ordinary fashion so far as this is concerned. It is viewed in anything but ordinary fashion, however. Light from above passes through the strip and strikes the mirror which is seen mounted flat on the base board under the apparatus. From this mirror the rays are reflected through the magnifying lens which stands at an angle to the mirror. The person desiring to inspect the reel merely puts it on the spool, threads it through in the usual fashion and starts to grind it out by means of the little hand crank shown. The reel passes between the light source and the mirror at the usual speed of 16 frames per second and the operator, adjusting the lens to the correct angle, looks through it and sees the magnified pictures flit across his visual field in the mirror. That is all there is to it. He can stop, start, reverse, repeat, etc., at his own pleasure and without misunderstanding, and he can view a short strip of a few feet just as easily as a full reel.

Miniature projector that speeds up the examination of film in the cinema studio

The Alula wing, of small span and bird-like appearance, which is claimed greatly to economize power

Airplane Wing of Bird-Like Lines

RECENTLY there was demonstrated at the Northolt airdome in Great Britain a novel wing design of interest This wing, which is known as the Alula, strikingly resembles that of a huge bird, arched at the center and tapering away to a point at the tips. In a practical test against a Bristol fighting plane of approximately the same horsepower, the machine equipped with the new wing attained an elevation of three thousand feet in 72 seconds, leaving the other plane far behind. Although in no sense a racing type, this test plane developed a speed of 180 miles per hour The new wing, which is designed by Alexander Holle, is applicable to any style of plane

A Screw-Lock for Doors

A NEW type of door lock has made its appearance Instead of projecting a square or oblong bolt into the keeper, this lock screws the door securely to the door frame A threaded cylindrical bolt, by a turn of the key, is propelled longitudinally so that the threads of the bolt mesh with the internal threads of the keeper on the same principle that one would screw together two pieces of metal. The advantage of such a bolt is obvious, and the lock is rendered impregnable against the attacks of the most powerful "jimmy"

An important, and heretofore unknown feature in locks, a most simple and ingenious device, manually operated from the inside, instantly disconnects the lock mechanism from the key-operated cylinder on the outside This makes the lock absolutely nonpickable against the finest of instruments, even the key itself

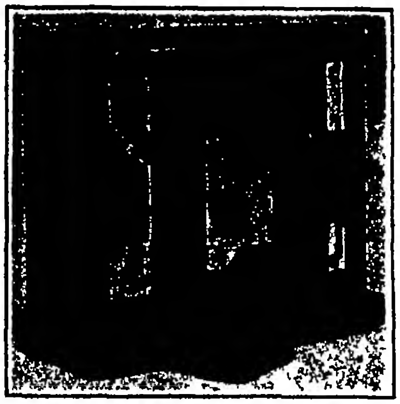
The entire mechanism is simple and durable, the absence of dogs, tumblers or operating springs making it impossible to get out of order It is, at once, non jimmiable, non-pickable and the most powerful door lock devised

An [illegible] tool for raising a car to work beneath it

An Improved Washboard

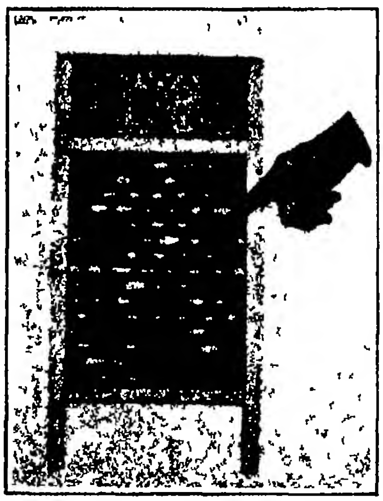
AN inventor has taken the rub out of the old washboard, and his new design makes use of wooden beads used as rollers to force soap and water through the material being cleansed.

The notion that rubbing clothes re-



The lock that cannot be picked or jimmied

moved the dirt seems to have been an old idea handed down from the ages As a matter of fact the rubbing simply forced the soap and water through as does this new principle washboard, but it took the material with it quite frequently



The rubless washboard

A Substitute for the Jack and the Crawler

WHERE the entire internal mechanism of an automobile must be dismantled, the problem of working beneath the car does not arise—dismantling, save for the trifling matter of the removal of a few bolts, etc., proceeds from above For minor repairs such as the removal and replacement of a connecting rod the slight amount of work that has to be done beneath the car does not warrant any such expenditure of time as is necessary to put the car on one of the large capsizing cradles which we have illustrated from time to time in the past Nevertheless if some means of avoiding the necessity of crawling under the car and working in a cramped position were available, convenience and economy would be served

The use of garage pits is one way out Consensus of opinion, however, stamps this as bad practice. Both the carbon monoxide from exhaust and the explosive gasoline vapors which make smoking taboo in the well-conducted garage are heavier than air, and without going to inordinate expense for ventilation of questionable effectiveness, the danger of a man working in such a pit being asphyxiated or blowing the shop up with the spark from a poorly connected light extension is so great that in some cities garage pits are absolutely prohibited.

A rather attractive effort to solve the problem comes from France. A stout steel bar is run through the ends of the springs, fore or aft. This bar is straddled by a high four-legged stand, through the top of which is threaded a long vertical screw member The bottom of this member carries a hook which engages the bar first mentioned When the screw is turned up, the whole apparatus acts as a screw jack, of unusual power and amplitude. The latter feature is so pronounced, in fact, that the car can be lifted no less than 28 inches at either end. This makes it possible to raise it to the most advantageous height to enable the work in hand to be done from a sitting or a standing posture at the mechanic's option In the bargain, for all such operations as testing wheels, axles, running gear, etc , for jacking up both wheels simultaneously for changing tires, mounting chains, etc , this device appeals to one as altogether superior

A Solar Stove of Tin Plate

COAL and water-power have one thing in common, when we use them, we are taking advantage of nature's long, roundabout processes for storing up the power that exists in the sun's rays and making it available for our purposes. We are not content to depend upon her storehouses, however, the problem of direct utilization of the energy latent in sunlight is one to which our inventors are continually turning their thoughts Installations described in the SCIENTIFIC AMERICAN several years ago for the purpose of heating water for household use interested Mr W S Gripenberg, of Masaby, Finland, to such a degree that in spite of the rather unfavorable climate of Finland for this sort of thing he commenced a series of experiments. A cooking apparatus which he has completed and installed is functioning to his entire satisfaction, and he supplies a drawing to show how it works

Mr Gripenberg took it for granted that for actual cooking more than mere exposure to the sun was necessary—some sort of collecting apparatus for the rays, he believed, would be essential And he made the rather surprising discovery that ordinary tin plate was in every way suited to this use. He points out that we must not confuse the requirements of heating with those of optics. Whereas all the rays emitted must be brought by an optical mirror to a focus within an area at most 0.004 inch square, this area in the case of heating a fairly large utensil becomes 5x5 inches—the area in the latter case being 1,500,000 times as great as in the former

Home-made sun-cooker that gives good service in the high latitudes of Finland

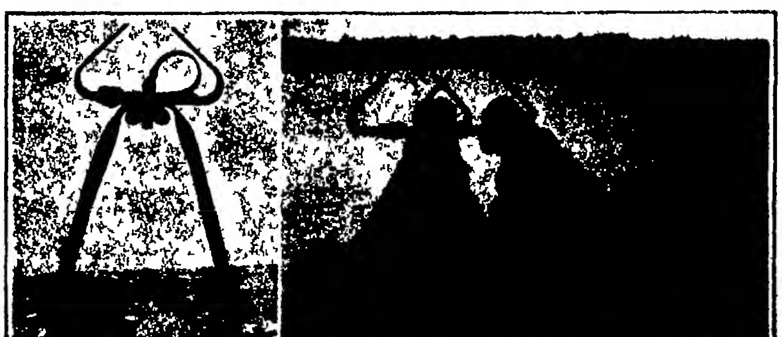
The construction, by ordinary means, of a spherical mirror of tin plate is of course out of the question But again Mr Gripenberg took advantage of the fact that the requirements of heating are rather rough He made seven strips of tin each three feet long and six inches wide and bent each into the form of a circular arc of five feet radius. He then brought these pieces together in a wooden frame so that they formed roughly a spherical mirror of five-foot radius and 2½ foot focus To some extent his strips overlap and to some extent they gape but the mirror serves none the less admirably It is necessary to readjust it about once each half hour, to compensate for the sun's shift of direction

Mr Gripenberg points out that in Masaby he has no experience with a sun higher than 53 degrees As low as ten degrees he finds serviceable on a clear day

The Both-Eyes-Open Sight

"UNHAPPILY this entails optical impossibilities" wrote E C Crossman then plain Mr, since become Capt., in discussing the conventional methods of rifle sighting in the SCIENTIFIC AMERICAN of December 15, 1915 "and a compromise, more or less satisfactory, has to be used with the open sight The mark, the front sight and the rear sight lie in three different planes, and the eye can see no two of them sharply at the same time"

Eli E Gregory, of Lewisport, Ky.,



Sighting with both eyes open: the sight itself (left) and the way it looks in action, with the crossing point of the two images lined on the target

holds basic patents on a scheme for avoiding all the troubles which Capt Crossman here suggests—avoiding them by nothing less revolutionary than the use of two eyes in aiming! Does it not seem strange that the binocular principle—the very thing that alone makes the world about us possess depth in our sight instead of looking like a picture on a sheet of paper, the very means by which we judge distances and relative positions—does it not seem peculiar that we should always have stuck so religiously to a system of aiming a gun that demands that we shut one eye and abandon this powerful method of seeing in favor of one fundamentally weaker? To Mr Gregory, at least, it did, and he has apparently succeeded in removing the necessity for behaving in so unnatural a fashion.

The new sight consists of an outline approximating an isosceles trapezoid, gained by setting, edge on to the shooter, a bent piece of sheet metal, beaded to prevent light reflection Our photograph shows one shape that is available, there are numerous others that will equally serve. The principle of operation is a familiar one Everybody knows that if he holds up a finger and looks past it with both eyes, he sees it twice—once with each eye In the same way, if this sight is held before the eyes, properly mounted on the gun barrel, it will be seen twice—once with each eye. If the shooter will then merely keep both eyes open and shift the gun sideways until the point at which the two images of the sight cross is directly on his target, he will have the lateral range of the object, obviously If at the same time the horns of the sight are properly shaped with reference to the muzzle velocity of the gun rifle, etc., so that the barrel has to be elevated to bring the intersection on the target when the latter is further and further away, we get vertical ranging, too This latter problem has to be solved separately and in advance for every muzzle velocity—the other solves itself in every case. And in every case we have instant aiming with both eyes open.

Portable Crane for Quick Handling

IN the handling of weighty objects, the problem to be solved consists in the lifting and handling of said objects on the very spot they are, whether in the fields or even on very irregular ground Therefore, it is necessary to erect on the spot a portable lifting apparatus, the transportation and handling of which should be most economical.

In order to do this it is necessary to have a device of light weight, taking up little space and easy to load and to move about in an ordinary vehicle It is also essential that it be strong, in order to withstand shocks and bumps, and that it be simply constructed in order to permit assembling with the minimum of help

A new system of portable lifting apparatus fulfills these conditions. It consists of two identical tripods, each of the three legs being of channel-steel with foot-pieces bolted on at the lower end and with riveted junction plates allowing pivoting axes to pass, at the upper end These pivoting axes are held by castellated nuts and washers and cotter pins.

At the lower half of the legs of tripods, hooks are placed for holding the chains connecting the foot pieces. The upper bracket is made of pressed steel with three junction plates riveted at the spot through which the pivots pass. Its inner side has two gripping plates holding fast the tripod to the transverse girder

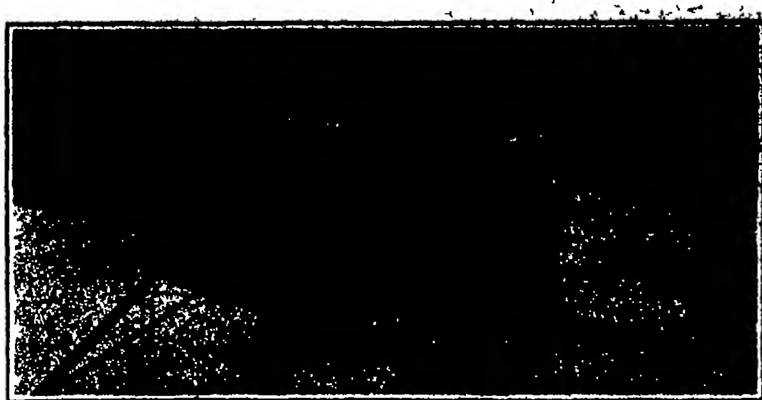
The latter is made up of two U-shaped channel sections standing back to back, which are connected at each end by a tube holding a bolt with thumb nut These two channel sections can therefore be easily separated. A space is left between them in order to allow the pulley hook to pass through or for placing the pulley [illegible]

The pulley [illegible] which goes between the channel sections has its flanges [illegible] with [illegible] pieces which enable the pulley to rest on the girder. In the first position, it is hoisted as it is by means of a small hand windlass. In the second position, the chains and hook are taken off in order to facilitate hoisting.

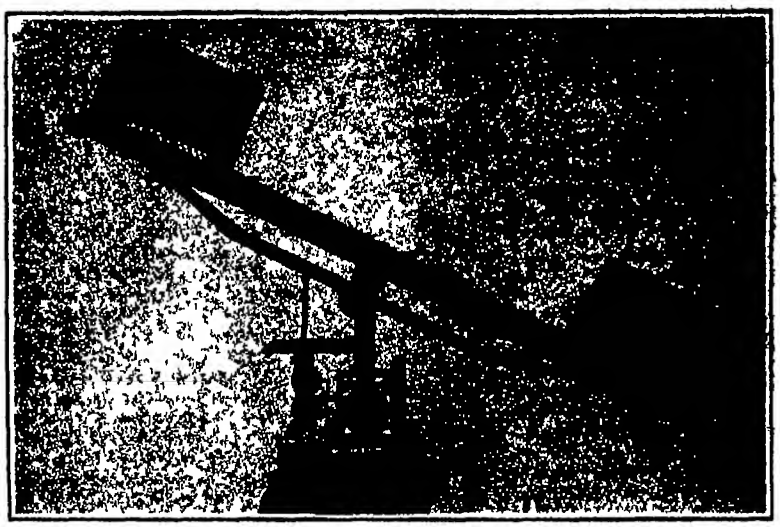
Extensions can be set to the legs of the tripod. These extensions consist of channel sections with a thumb-block adjustable at various heights. The latter follows exactly the shape of the foot-piece of the leg of the tripod and two clamps are sufficient to hold the foot-piece tight against the extension.

The extensions are used, of course, to lift up the whole apparatus or else to make up for uneven ground under one or several of the legs of the tripod. In order to prevent the legs sinking in soft ground, a channel-section steel plate can be mounted at the lower end of the extension. These plates can be mounted on the foot-pieces as well as on the extensions.

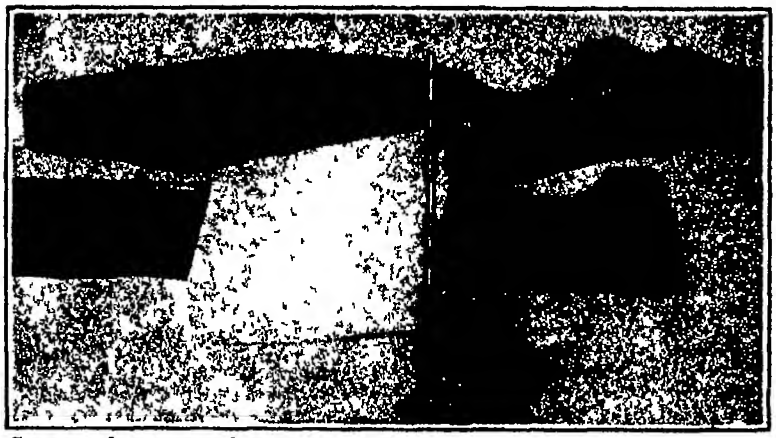
When the pulley rests on the girder, it is held tight to it by means of four plates which hold its shoulder to the upper wings of the two channel sections. The pulley can then be stopped at any spot on the girder. Only the moving equipment rises above the girder and the chains which unite it to the pulley pass on either side of the girder The maximum lifting height is thus considerably raised.



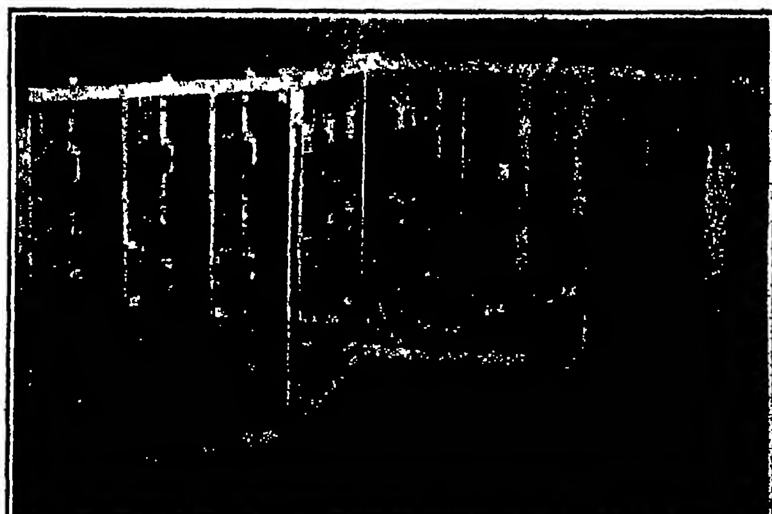
A portable crane that can be carried in an ordinary passenger car



The machine used by a French investigator of mal-de-mer to make his animal subjects seasick



Correspondence trays that are always there when they are wanted, and always out of the way when they are not



A bath cabinet that occupies little more space than a folding screen

Seasickness by Machine

SEASICKNESS does not sound like the sort of ailment for which one might hope to find a serum. Nevertheless, Dr. Poserski, head of the Pasteur Institute Laboratory in Paris, has been looking for a serum for it, and actually believes he has found one. Obviously, however, it has been necessary for him to test it out on cases of actual mal-de-mer, and it has not been convenient for him to embark his laboratory aboard ship in order to meet this requirement. Our photograph tells the rest of the story, if we can't use a ship, we must have a seasickness machine. The animals on which Dr. Poserski has experimented have been ridden about in the air in the baskets on this machine, which was carefully designed by M. Jouan, a prominent French engineer, to simulate the motion of a ship's deck. Judging from the doctor's announced success in his investigations, the machine must have been a success in its field.

Adjustable Correspondence Trays

A NEW office desk accessory which extends the capacity and utility of the desk as much as a new glazed porch adds to the service of a house, is a set of adjustable correspondence trays supported in a tier by an upright post screwed or clamped to the edge of the desk or table. Any one or all can be swung over the working surface by the stenographer, beneath her eye or hand; then moved outward, leaving the entire desk free; or removed easily and carried away. Two, three or four trays, mounted upon a grooved rod around which they revolve, make a standard set, but a larger number of units can be provided to special order. Their finish is mahogany or oak, with metal index holders. Trays can be had in both letter and cap sizes for the handling of correspondence and papers.

A Turkish Bath Behind the Door

A FOLDING bath cabinet, [illegible] as compactly as a screen is here illustrated. This device is equipped with [illegible] which offer to the owner [illegible] Turkish bath [illegible] it [illegible]

The Service of the Chemist

A Department Devoted to Progress and Achievement in the Field of Applied Chemistry

Conducted by ISMAR GINSBERG, Chemical Engineer

Gasoline from Fatty Oils

AT the present day a movement which is vitally interesting the French nation is the strenuous effort that is being made to circumvent the necessity of importing large quantities of petroleum products, especially gasoline and lubricating oils, by the location of oil fields within the country and also by developing new sources of supply of these materials from raw products produced in France or the French Colonies. An example of the intense manner in which the French are tackling this problem, which results in their considering very strange and difficult methods and processes of probably little practical importance, is exemplified in a recent communication to the Academie des Sciences. In that report it is stated that there can be produced from linseed oil and other similar oils a product which is very volatile and resembles gasoline very much in its behavior. The process involves the catalytic treatment of linseed oil with resulting elimination of water and hydrogen.

By-Products from Yellow Pine Stumps

THE United States Department of Agriculture has issued a very interesting bulletin, entitled, "The Distillation of Stumpwood and Logging of Western Yellow Pine." In this report it is stated that the stumps which are left behind after logging operations are very rich in resinous products, for which there is a ready market, as crude pine wood oils are being used considerably in the flotation process of concentrating ores. Plants which would be erected to extract these oils from the stumpwood would have to be of the single retort movable type, so that when the stumps in the immediate locality of the plant have been consumed, the latter can be dismantled and set up again at another point with very little difficulty.

Non-Fermentable Sugar Syrup

THE United States Bureau of Chemistry has evolved a process of obtaining a rich, heavy sugar syrup, which will not ferment or crystallize. This is accomplished through the use of invertase, an enzyme which is derived from yeast. One pound of the invertase enzyme is sufficient to invert 800 gallons of syrup, that is, convert cane sugar or sucrose into a mixture of grape and fruit sugar. The invertase is added during the process of making the syrup.

Waterproof Sand-Paper

ACCORDING to the "Paint, Oil and Chemical Review" of February 1, 1922, a new article has appeared on the market in the form of a waterproof sand-paper. This is especially useful in the painting of automobiles, where it can be used with water at a considerable saving of time in the place of pumice stone, in rubbing out color and color varnish coats, and also in first coats of rubbing varnish.

A [illegible] Photographic Copying Process

[illegible] sensitized with a 20 per [illegible] of ammonium ferricyanide. The copying process takes place [illegible] length of time as in [illegible] paper. The black [illegible] with a 2 per cent solution of silver nitrate, the excess iron is removed with a 1 per cent solution of oxalic acid and the picture is fixed with the aid of a 10 per cent solution of hypo. To obtain a harder print just a few grains of ammonium bichromate are added to the sensitizing solution. For further details the reader is referred to the "Photographische Rundschau," vol. 57 (1921), pp. 153-156.

New Development in the Olive Oil Industry

RECENTLY there has been developed a new process of extracting the olive oil left behind in the filter cakes in the regular refining operation. This process will very likely have a very important influence on the industry as a whole. In the former extraction process carbon disulfide was employed and the olive oil, obtained thereby and called sulfurol, possessed such a bad odor that its use was rather limited. In the new process trichlorethylene is used as the solvent, and after it is evaporated there is obtained an oil which possesses the odor of pure, refined, edible olive oil. However, this is true only when the oil, which is known as tri-olive oil, is fresh. According to "Seifensieder Zeitung," vol. 48, page 310, there does not appear to be any great technical difficulty standing in the way of rendering this oil fit for edible purposes. The tri-olive oil is not so green as the sulfurol, and, furthermore, it is more saponifiable than the latter, making it better for soap manufacture.

Sweet Potatoes as a Source of Alcohol

ACCORDING to the Journal of the Department of Agriculture of South Africa (1921), pp. 229 and 340, the sweet potato is suggested as a possible source of alcohol for fuel purposes. Compared with the ordinary potato, the sweet potato is more easily grown and contains more starch. Its composition is 72 per cent water and 25 per cent of starch and sugar, against 75 per cent water and 16 to 24 per cent starch in the ordinary potato.

Building Material from Sugar-Cane Bagasse

AT Marrero, La., there has been erected a factory for making building material from sugar-cane bagasse. The equipment of the mill is very much like that in a paper factory. The bagasse is chipped, cooked and washed, and then sent to beaters, where it is worked up until the fibers are of the proper length. A special machine converts the pulp into board and this is dried for four hours, emerging as a finished product, quite dry and hard. It is known as celotex, and can be worked just like wood, and is solid and homogeneous.

New Use for Linseed Oil

THE Chemische Fabrik Mensel & Co. of Liegnitz, Germany, has patented a process of making a rubber substitute from linseed oil. According to this process, the oil is heated for from three to four hours at a temperature of 110 to 120 degrees Centigrade at atmospheric pressure or in a vacuum in the presence of very finely divided metals, such as reduced iron, magnesium, etc. In this way a solid product is obtained which can be readily molded. Variation in the heating temperature and in the time of heating as well as in the amount of air coming in contact with the material gives products of different properties. The new material is soluble in various solvents, such as carbon bisulphide, turpentine, benzol, etc. It resists the action of acids and alkalies and is hardened by sulfur, and after the addition of anthracene, anthraquinone or steatite, it can be converted into a rubber-like mass. It can be used as an insulating material and as a substitute in making cables. It can also be used in the manufacture of linoleum, for waterproofing materials, etc.

Recovery of Potash from Wool Washing

THE Bureau of Chemistry is giving considerable attention to the development of natural sources of supply of potash. It is known that the wash liquors obtained in the washing of wool contain potash, but in the ordinary process these liquors are so dilute that it does not pay to extract the potash salts from them. The Bureau is experimenting with wool washing machines to see if it might not be possible to wash the wool in such a manner that the wash liquors recovered would contain a sufficient concentration of potash to render its recovery commercially feasible. The average fleece contains about 4 per cent of potash. There are about 600,000,000 pounds of wool scoured each year in this country, and even if only 3 per cent of the potash were recovered, this would mean the production of 18,000,000 pounds of actual potash yearly, which would be available for making fertilizers.

Tellurium Compounds Increase Efficiency of Gasoline

THERE have been so many wild reports about new motor fuels, derived from "cabbages or onions," or, indeed, from merely air itself, that are immeasurably superior to the old reliable gasoline, that the average individual, when he reads about a new invention of this order, is apt to be very skeptical not only about its commercial applicability, but about the honesty of the so-called inventor. However, there has recently appeared a note in the daily newspapers, which was afterwards elaborated in a report to the Engineering Division of the National Research Council, concerning a new gasoline composition, developed in the laboratories of the General Motors Corporation, which is reputed to increase the efficiency of the motor fuel by 100 per cent. While exact details are still unavailable, and while we are naturally prejudiced against these new, wonderful substitutes for gasoline, especially when they are heralded in unscientific form in the daily journals, nevertheless there appears to be an air of reliability about this report that makes it worthy of mention in these columns. It is stated that the improved gasoline composition is secured by the addition of a small amount of a tellurium compound. The automobile which was used in making the tests was equipped with a special high-compression engine. It was found that the high compression resulted in a greatly increased power and in a higher efficiency of the fuel. If all the gasoline used in this country were to be treated with this tellurium compound, it would be necessary to develop new sources of supply of tellurium and build plants for making the compound. The present production of the metal is very limited.

New Aluminum Alloy

A NEW aluminum alloy has been developed in Germany which is sold under the name "silumin." The alloy contains 11 to 14 per cent of silicon and 86 to 89 per cent of aluminum. Its specific gravity is 2.5 to 2.65, tensile strength, 20 kilograms per square millimeter, and hardness at room temperature, 60 kilograms per square millimeter, with a 500 kilogram load and a 10 millimeter ball. The alloy is unaffected by wet steam, and resists concentrated nitric acid better than aluminum, which it resembles very much. The alloy is made from its elements directly or in the electric furnace. For further details, see the "Chemiker Zeitung," December 22, 1921.

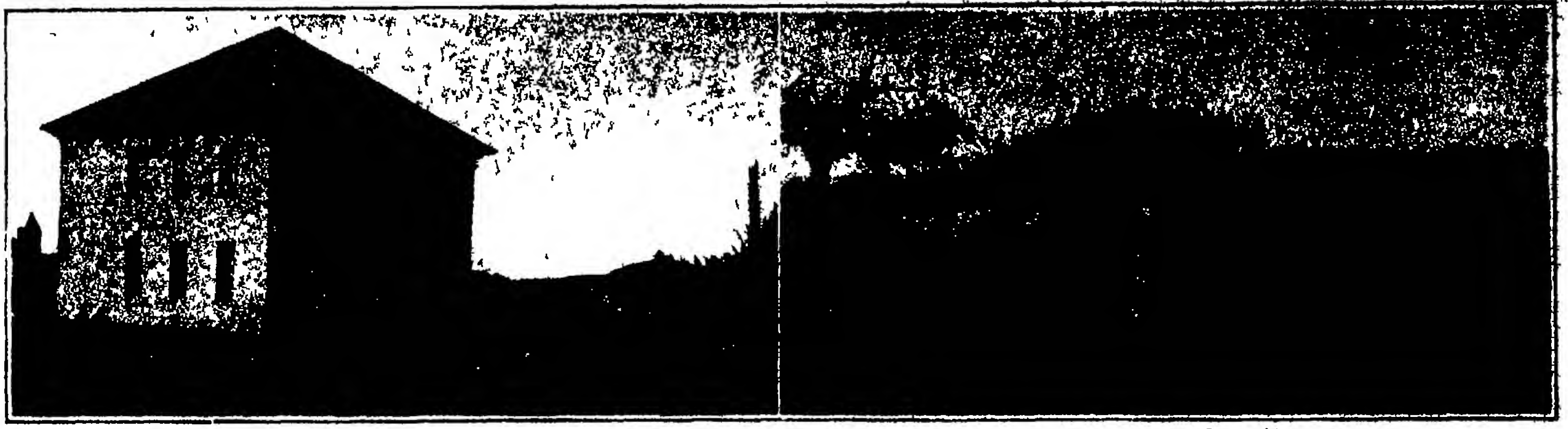
Soda Lake in Siberia

THE discovery of a lake, rich in carbonate of soda, in the neighborhood of Kulumda, Siberia, has been announced. The lake is located in a very fertile region, and active steps are being taken to exploit the discovery and erect a soap factory in the immediate vicinity of the lake.

Mercury and Its Use

THE principal mercury mineral is cinnabar which is mercury sulfide. The smelting of the mineral takes place in furnaces or retorts. In the furnaces the mineral is subjected to direct contact with the flame from the fire-box, and the volatile products of combustion mixed with a certain amount of dust and vapors of mercury, escape from the furnace into the condensers. In the retorts the mineral is heated indirectly and the products of the distillation are not contaminated with dust and other impurities from the hot flames. The furnaces are used especially for treating rich ores, and are very economical, while the retorts are used for ores that are not so rich in mercury.

The uses for mercury are as follows. First in the manufacture of various pharmaceutical products, such as calomel, corrosive sublimate, colloidal mercury, etc. The oxides of mercury are used in the manufacture of acetic acid and phthalic anhydride as catalysts. Mercury is also used as a catalyst in the manufacture of picric acid directly from benzol. Fulminate of mercury, made by the combined action of alcohol and nitric acid on mercury, is used as the principal detonating explosive for military and commercial purposes. Fulminate of mercury is the main constituent of blasting caps. Sulfide of mercury is the well known brilliant red pigment, vermilion. Metallic mercury finds use in many electrical and thermal instruments, such as thermometers, the mercury arc light and rectifier of alternating current, various physical instruments such as barometers, manometers, etc., are made with the aid of mercury. It is also used as the cathode in the manufacture of various products by electrolysis, as, for example, in the manufacture of caustic soda and chlorine from common salt.



Moving a school-house and pulling old stumps with tractors—work that is not usually expected of such machinery

Jobs for the Tractor Outside the Daily Routine

EVERY tractor owner knows that, with a little ingenuity, he can do a lot of things with his machine that are not in the books. The general notion of doing unusual things with a tractor is indeed an old story; but this does not mean, necessarily, that some particular display of tractor-operating ingenuity is not on its own merits of interest. Two such items we illustrate at the head of this page

The Litchfield, Neb., schoolhouse had its moving day not so long ago Instead of adopting the more traditional procedure of hauling it with stationary engine and winch, the contractor decided that he would get it moving and keep it moving So after he got it jacked off the old foundations he constructed a good sledge-and-roller arrangement under the building, and when the tractor shown in the picture was eventually harnessed to the schoolhouse it walked right away with it Communities that have had a street blocked for weeks by a house-moving job might profit from this example

A job that happens more often than house-moving is stump-pulling Where a 12 25 horsepower machine was none too husky for the larger task, the cut over land may have its teeth pulled with the aid of a smaller machine—the one performing before the camera is of 5-10 horsepower rating, and, as the picture suggests, it is of ample power for the task

How the Stability of a Ship is Determined

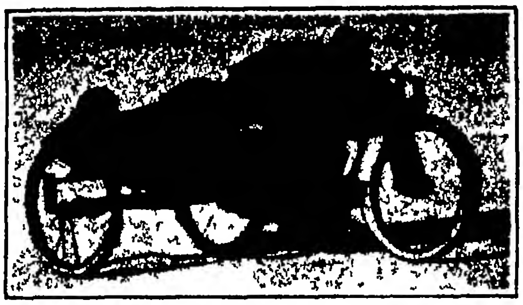
THE U S S "California," as many of our readers know, is one of our new vessels which is so heavily armored and so adequately protected that her designers believe she could withstand the blow of a 4000-pound bomb. Three of her sister ships are already complete and in commission Our present photograph shows her before the superstructure was built up, while she is being submitted to what is known to the technical expert as the 'inclining experiment' Tracks were laid across the vessel, on which cars carrying heavy loads of steel, some 20,000 pounds in weight, were drawn from side to side The object of this experiment, which is a perfectly normal operation in the construction of every ship, is to discover how the vessel lists or heels under various positions of the load In this way her stability and her medicentric height are determined This is always an important consideration in obtaining a steady gun platform.

The "California" is tested for her stability by means of loaded cars run on tracks from one side of the vessel to the other.

One Hundred Miles per Hour

THE visual impression of speed is not always to be trusted, as is well known by any motorist who has made the interesting discovery that 30 miles per hour in a flivver looks about as fast as 50 in a heavy six. It is not merely the greater vibration and the more pronounced jumping of the smaller car that add to its apparent speed, the very size of the large object makes its motions seem more deliberate. The baseball fan knows well that a huge bulk like Hans Wagner, Napoleon Lajoie, or the immortal Babe Ruth looks like a veritable ice-wagon on the base paths, but none the less covers the distance from second base to the plate about as fast as the smaller and more graceful man.

And so when a motorcycle shoots past us on the road,



100 miles an hour on the Daytona beach

we are apt to tone down the initial impression that it must be doing 60 or 70 at the very least, and decide that after all it was probably going no faster than the ordinary automobilist when he is in a hurry That the motorcycle really is capable of extreme speeds we will, however, realize if we recall the ease with which the cop mounted on one overhauls all but the very fastest and most recklessly driven cars And here is a picture that gives further evidence of what the motor bike can do even when trammeled with a side car It was taken on the sand at Daytona, and in spite of the fastest of shutters and the briefest of exposures, shows the object considerably blurred and distorted by motion The speed in this particular case was 100 miles per hour, as indicated by speedometer on the machine Needless to say, the gentleman is not driving for his health he is in fact tuning up for one of the races for which the sands of the eastern Florida coast are so admirably suited, and which in turn have contributed to the fame of these beaches.

Tests of Manila Rope

THE Bureau of Standards has recently issued Technologic Paper No 198 on this subject It is ready for distribution by the Superintendent of Documents, Government Printing Office, Washington, D C

The results of tests on manila rope discussed in this paper represent some of the data which have been accumulated at the Bureau during the past few years. Most of the specimens were submitted by various rope manufacturers on purchase orders for government departments and a fixed procedure was adopted by the laboratory in testing all of them. The rope ranged in diameter from ½ to 4½ inches, inclusive, and consisted of commercial 3-strand, regular lay ropes. The breaking load, weight per linear foot, number of yarns, and the lay of the rope and strands as well as the elongation, were measured. The average breaking load was found to be approximately a quadratic function of the diameter of the rope. It is expressed quite closely by the equation

$$L = cd\ (d+1)$$

in which L is the load in pounds, c is a constant equal to 5000, and d is the diameter of the rope in inches. The ropes showed a continually varying modulus of elasticity and no well-defined proportional limit. The number of yarns composing a rope may be expressed approximately by the equation

$$N = kd\ (d+0.4)$$

where N = the number of yarns, k is a constant equal to 50, and d the diameter of the rope in inches.

The test results cover sufficient range and show such consistency that it is believed that the formulae deduced may be used safely for 3-strand regular lay manila rope of sizes between ½ and 4½ inches in diameter

Spectrum Transmission Data

SCIENTIFIC Paper of the Bureau of Standards, No. 418, entitled, "Spectroradiometric Investigations of the Transmission of Various Substances, II," gives transmission data in the spectrum extended from 0.6 microns to 3 microns using a mirror spectrometer, a quartz prism and a vacuum thermopile. The substances examined are a series of mineral, animal, and vegetable oils (containing fatty acids,) nitrocellulose, bakelite, and selenite It is shown that the absorption spectra of the oils are so nearly identical that they cannot be used for detecting the adulteration of one oil with another The paper concludes with an examination of the accuracy of the author's previous work using a rock salt prism It is found that using the recently determined refractive indices of rock salt, the corrections to the observations of 1903 to 1905 are of the order of 0 01 microns to 0 02 microns and hence negligible This paper is now ready for distribution, and anyone interested may obtain a copy by addressing a request to the Bureau of Standards until the free stock is exhausted

Hot Weather Sunshades that Sit Over the Hat

TOURISTS in Greece during the past summer have been struck by the "hot hats" offered on the streets of Athens. They are of light silk or muslin, without a crown of any description, as they are built over a large, light frame that fits over the regulation hat. Though known under the name of hats, they are in better truth sunshades. They are said to lessen materially the discomfort of the Mediterranean sun, and to be in general use in Greece Perhaps we shall yet see them on this side of the ocean

The trick "hats" of the [illegible] in Athens

Our Readers' Point of View

The editors are not responsible for statements made in the correspondence column. Anonymous communications cannot be considered, but the names of correspondents will be withheld when so desired

Asphalt vs. Concrete

To the Editor of the SCIENTIFIC AMERICAN

It goes without saying that readers of the SCIENTIFIC AMERICAN are always entertained and instructed, but it must happen sometimes that your writers get the wrong slant. In the issue of October 1st, page 230, is an editorial on "The Illuminated Highway," which contains the following statement "Today we admit, even when we do not build our roads of concrete, that concrete is the stuff for roads." This statement, made without qualification, leaves out of consideration some very important points to which I am sure you will give due weight as I bring them to your attention:

In constructing a concrete road, the question immediately arises as to whether the concrete should be unsurfaced with any other material or should have an asphaltic top such as is customarily laid in all of the principal cities and on a large portion of our country highways. If the asphalt surface is applied, a very marked saving in the amount of cement is effected for the reason that when concrete is used for a foundation it requires only one part of cement to nine parts of sand and stone, while the general practice in constructing an unsurfaced portland cement concrete road is to use one part of cement to four and one-half parts of sand and stone. For a mile of 18-foot road 7 inches thick about 4000 barrels of cement are required. A saving of approximately one-half of the cement requirement is very well worth while, for with cement at, say, \$2.50 per barrel this saving would be about \$5000 Furthermore, the base would be thinner because of the asphalt top and would thus effect a still greater saving

Not only is there a difference in the cement requirements, but engineers generally are turning to metal reinforcement for portland cement concrete roads where no asphaltic top is applied Pennsylvania is laying most of its state highways with heavy metal reinforcement, and in North Carolina a decision has been reached to increase the metal reinforcement requirements to 100 pounds per 100 square feet. On this latter basis the cost for reinforcing metal alone would be \$4750 per mile. With the asphaltic top no such reinforcement is necessary From this you can see that the cost of laying a pavement combining all of the good points of portland cement concrete and of asphalt is very little greater than the cost of laying unsurfaced portland cement concrete and no greater than the cost of the latter if it be reinforced with metal.

There are today over 500,000,000 square yards of asphaltic pavements in cities alone, and their excellence is indicated by an extract which I quote from the official report of the Engineer Commissioner of the District of Columbia for the fiscal year ending June 30th, 1920: "The average age of [asphalt-paved] streets resurfaced in 1910 was 25.8 years, in 1911 was 24.5 years, in 1912, was 25.8 years; in 1913, was 26 years, in 1914, was 28.5 years in 1915, was 28 years, in 1916, was 29 6 years, in 1917, was 27 years, in 1918, was 26 years, in 1919, was 26.7 years, in 1920, was 23.6 years."

I have no desire to speak in derogatory terms of unsurfaced portland cement concrete pavements, but, in advocacy of the asphalt top, I would call your attention to the well known fact that portland cement concrete is very porous, readily absorbs water and if not protected by some waterproof covering is subjected to an extreme amount of expansion and contraction When the concrete slab is laid directly upon an earth subgrade, the slab is subject to the most trying conditions because of the difference in the moisture and temperature conditions of the upper and under side of the slab. If an asphaltic top is applied, the concrete slab receives a maximum protection against temperature and moisture changes. In the absence of such a top the concrete slab is ultimately shattered by the cracking due to expansion and contraction. I need only cite to you the experiences of the California and Maryland state highway departments, both of which have found it necessary to resurface a considerable yardage of portland cement concrete pavements after a service of five or six years. If the asphaltic top were applied at the outset, the repair would only be to the surface as the base would remain intact.

As an engineer you must know that apart from moisture and temperature changes the agency most destructive to highways is impact. A striking illustration of this was brought out in tests by the U. S. Bureau of Public Roads which showed that under given conditions a static load of 7500 pounds might deliver a blow equivalent to 20,000 pounds static load if the weight were represented by a truck wheel moving at speed of fifteen miles per hour and having a drop of ½-inch, a condition not uncommon at joints in a portland cement concrete road. To oppose impact by a rigid slab is necessarily to choose a costly alternative where it is possible to adopt the simpler plan of opposing a cushion or flexible body to take up the shock. Asphaltic surfaces unquestionably possess the ability to absorb the shock or impact and give decided protection to the foundation It is cheaper and more effective to use the asphalt top than greatly to increase and reinforce the portland cement concrete slab.

So successful has this material proven on the Pacific Coast that over 12,000,000 square yards of the all-asphalt pavement have been laid, in which asphalt has been combined with sand and stone to form the entire slab, resting in most cases upon a thin insulation course of broken stone. In Visalia California, this type of pavement has been subjected to heavy traffic for 26 years with no maintenance cost and is still in good condition There are hundreds of examples of long service with no maintenance cost for the all asphalt type of pavement. I feel sure that you do not mean to discard these incontrovertible facts by stating that "we admit that concrete is the stuff for roads"

J E. PENNYBACKER.

Not Fireproof

To the Editor of the SCIENTIFIC AMERICAN

In looking over the November issue of the SCIENTIFIC AMERICAN my attention was arrested by the article on page 130 entitled "A Safety File for the Home," in which the statement is made that it is a "semi fireproof filing cabinet for the home" Further on the statement is made that it "serves every purpose of a safe" We assume that the intention is to convey the impression that the cabinet will protect papers stored in it from fire, not that the metal box itself will not burn under ordinary fire conditions. When we know from actual test that we cannot secure fire protection for even one hour in a safe except by use of heat insulating material two inches or more thick, it does not require any guess work to say that a thin wall metal box will afford so little protection as to be negligible We all know how readily heat goes through the walls of a stove, and that paper laid against it will take fire. With the cabinet the condition is simply reversed, the fire is on the outside and the papers on the inside.

While we have not made a test of a cabinet of this form, we have tested ordinary metal vertical letter files, which, if anything, would probably afford more protection than the cabinet shown, with quick destruction of contents as a result. If the inventor or promoter has any doubts, let him put one of the cabinets in the fire box of the nearest house-heating furnace with a brisk fire in it and see how long the papers are protected The result may be disappointment, but it will save him money and embarrassment.

We trust that our remarks will be taken in the spirit in which offered—to give helpful information about a subject upon which we are specializing and about which we find there is much misinformation, namely, the protection of records from fire. It is not uncommon to lose sight of the fact that more than incombustibility is required to provide fire resistance. Heat insulation also is necessary As a matter of fact, a well-made hardwood box with walls one-half inch or more thick and with a good cover would afford protection for a longer time than a single wall box of thin metal, because of the better heat insulating properties of the former Of course it would not afford protection for a sufficiently long time to be of any practical value

M L CARR.

Marietta, Ohio.

What Not To Do to a Car

To the Editor of the SCIENTIFIC AMERICAN

Having been an automobile owner for 17 years, on receiving the first SCIENTIFIC AMERICAN MONTHLY I read at once the "pointers" by Harold Hollingshead.

Some of his advice is very unorthodox and some of it would be dangerous if taken seriously by those who believe that everything in print is "law and gospel," and especially so when it appears in the SCIENTIFIC AMERICAN

I will mention some of the things that he advocates that no well informed owner would think of practicing or permitting

Oil is recommended as a cure for leaky tire valves. Certain parts of valves are made of rubber, and anyone who wants to find out what oil does to rubber can easily do so. Tire manufacturers say "Keep oil away from tires." Oil in a valve causes no end of trouble and should never be resorted to without realizing that the valve "inside," at least, will be ruined Power tire pumps are furnished with devices to filter the air free from oil, and such filters are not provided for the fun of it. "There's a reason"

In these days of heavy fuel and diluted crank-case oil, automobile manufacturers conspicuously display on cars and elsewhere this admonition "Change oil every 1000 miles." Sometimes they advise a change of oil every 500 miles.

It is therefore astonishing that anyone should recommend a time instead of a mileage basis. Crank-case dilution depends on the number of miles run, kind of fuel used, and on several other factors, but time is not one of them. Mr Hollingshead must have a "little refinery in his home" that keeps him supplied with old fashioned 80-degree fuel that does not cause dilution

Flushing radiators every two weeks is about twenty five times oftener than is done on most cars where cooling systems give no trouble

Spark plugs ought to run months instead of weeks without cleaning 'Emery on the points' is never needed At all times the points are burned perfectly clean where the spark occurs. Any perfect spark plug will only need to have the loose carbon scraped off and the insulator or porcelain perfect and clean

Neatsfoot oil is all right for a leather clutch, which is probably what the writer meant, but he does not say so.

Mr Hollingshead says, near the close 'In starting and stopping at all times shift to low or intermediate gears, which will save the strain which would come on the motor by pulling in high gear" I have wasted (?) hours over the fourth dimension and Einstein, but now I can transfer my attention to this problem of stopping in low gear or intermediate

Mr Editor were those serious and honest-to-goodness "pointers, or are you running humorous articles incog? The SCIENTIFIC AMERICAN has been, and, judging from the first issue of the Monthly, is going to continue to be, indispensable to me I had no idea however, that it was going to contain a comic department.

Hartford, Conn CHAS EDW PRIOR, JR.

Authority and Usage

To the Editor of the SCIENTIFIC AMERICAN

I note with interest an editorial on page 178 of your issue for September 10th on "Technical English," in which you take exception to the frequent use of 'data" as a singular Such use is, of course grammatically wrong, though somewhat justifiable psychologically if one sees "data" with his mind's eye on a single column of figures. I suppose after all grammar is but a matter of psychology, so that, by usage, 'data" can be made both singular and plural. The word 'datum", if used by the man on the street, sounds pedantic, does it not?

I have before me the "Standard Home and School Dictionary," 1911 edition, revised and enlarged by Prof C M. Stevans, Ph.D The entry under 'data' is as follows "Something given or admitted some fact, proposition, quantity or condition granted or known, from which other facts, propositions, etc are to be deduced.' Thus, Professor Stevans apparently discards datum' altogether and would have the public use 'data' in the singular

This and the many questions concerning business English leads me to suggest what I have often thought of before—an academy for the English language which might have headquarters in England but a live branch in America. I believe that the professors of English throughout the country on the whole, would oppose such an academy, but that the man on the street would not. I believe, however, that if it were established there would be latent desire on the part of many professors of English to become members.

Suppose, then, we start this academy Suppose you and I become the initial members and then surround ourselves with a half dozen others, so as to make a real beginning As I do not profess to be competent to set a standard on requirements in the use of English but only to be a target for questions I should like to make a proviso that my membership in the academy should cease at the first annual meeting and I be eligible for election only after the academy has been going for a definite fiscal year

This is but one of several moves on my part for disposing of many questions that are afloat. As I see it, the world needs people with *initiative* to pave the way, while there is plenty of *ability* to follow G W LEE.

Boston, Mass.

Wanted:—Science Jingles

To the Editor of the SCIENTIFIC AMERICAN

I am endeavoring to collect verses of a more or less humorous nature whose subject matter relates to the sciences, with the intention of publishing an anthology of such poetry, under the title of 'Jingles of Science" It has occurred to me that there may be a large amount of such poetry filed away by some of the great number of chemists, physicists, engineers, and others interested in scientific matters. This material is quite unavailable to me at the present time, by reason of its non publication Will you kindly grant me space for this appeal to your readers to send me copies of such verses as are available to them, and which in their opinion are worthy of publication? Whenever possible, I should like to have the name, or names of the authors accompany each contribution Any verses, grave or gay, referring to any of the sciences, sent to me at 7 St. Paul St., Cambridge, Mass., will be sincerely appreciated, and duly acknowledged. CHARLES E. RUBY

7 St. Paul St., Cambridge, Mass.

The Heavens in May, 1922

The Extreme Accuracy with Which Our Measures of Star Distances Is Conducted

By Prof Henry Norris Russell, Ph.D.

THE astronomer, perhaps beyond other students of nature, has a passionate interest in precision of observation Accuracy of measurement is of course worth while for its own sake—though only those who have tried it know what a multitude of pains must be taken to improve upon the successes of the past. But the student of the stars is always tantalized by the realization that some further advance of knowledge—perhaps long and eagerly desired—lies just out of reach so long as our observations remain what they are and would come within our grasp could we but make our measures more precise

A very good example of this steady search after methods of ever higher precision is found in the history of the measurement of the distances of the stars. The principle involved—the apparent shift of the star's position in the sky, as the earth swings from side to side of its orbit—has been fully understood for two centuries. The long struggle has been a matter, not of theory, but of practice and the student of observing conditions and the designer of instruments have won the battle

A century ago the only way to find out where a star was in the sky was to measure its distance from the pole, or from the zenith with a meridian circle When such large angles have to be measured, an error of one thousandth of one per cent may amount to a whole second of arc—which is far larger than the whole parallax which we are seeking *It is not surprising, therefore,* that the relatively imperfect instruments of a century ago did not prove equal to so delicate a task Success came when Bessel with his newly invented heliometer, started to measure the distance of a star from its near neighbors in the sky and to detect the changes in these caused by the parallactic displacement for these were small distances, comparatively, and the same percentage error in them did not amount to nearly so much

Things to Watch Out For

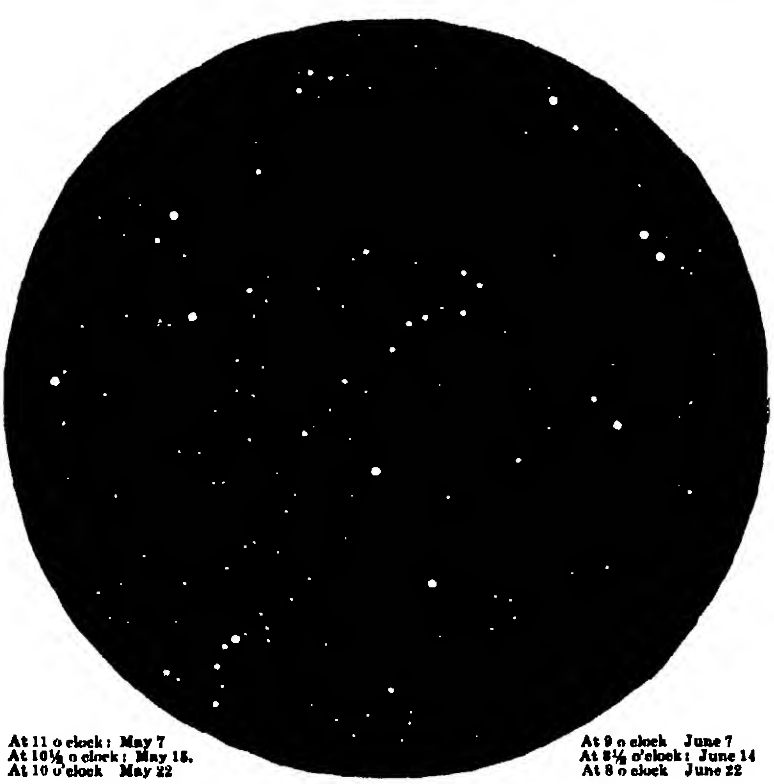
Nowadays, when we take photographs of the stars with great telescopes and measure the images upon our plates the gain both in speed and in accuracy is very great, and we seem near mechanical perfection in our processes But are our results really as accurate as they look even though successive observations on the same star agree excellently well? Or is there some concealed source of error, which still lies lurking in our observations? If we were not very careful there certainly would be For example our star is most shifted by parallax when it is 90° from the sun in the sky If we want to observe it then we will find it in the west after sunset, or in the east before sunrise The effects of refraction of light in our atmosphere will be different in the two cases. This would not matter if they were the same for all the stars in our photograph but for stars of different colors they are different Our photographs, therefore if taken at these times, would exhibit spurious shifts due to refraction, confused with the real shifts, due to parallax To be sure that we are rid of these, we must take all of our plates, morning and evening, when the sky is in the same part of the heavens (say on the meridian) even if we have to observe it when the shift due to parallax is considerably smaller

Again, it is found by experience that, in order to get the greatest accuracy of measurement, the images of our stars must be correctly exposed. If they are over-exposed (*deep and fuzzy*) or under-exposed (*gray and feeble*), the measures will be inferior Various ingenious screening devices have therefore been used, to cut down the brightness of the principal star and make its photographic image of about the same intensity as the others, so that the exposure can be made correct for all at once.

But when these precautions and many others have been taken, have we got rid of all our errors?

The first, obvious, test is to compare the results obtained by two observers There are many stars for which the parallax has been determined at two or more observatories. The individual measurements do not agree exactly—and this is not alarming for no single determination can be free from all error The more important question is whether the results of some observers tend, on the average, and all the time, to come out larger than those of others. Careful investigations by Boss, van Maanen, and other astronomers show that it is probable that minute differences of this character exist For example, the parallaxes determined at Allegheny Observatory are, on the average, a little smaller than those found for the same stars at Mount Wilson But the differences so revealed are *most gratifyingly small, amounting at most to a few* thousandths of second of arc

Small as these differences are, they must be taken into account in the most refined work—but the question then arises If different observers disagree even minutely, which is right (or most nearly right)? A very ingenious attempt to solve this hard problem has just been published by Strömberg who has long been associated with Adams in the work on spectroscopic parallaxes at Mount Wilson As may be remembered, these spectroscopic parallaxes are derived by estimating the true brightness of a star from its spectrum They may be in error but the error will be proportional to the parallax itself and not a fixed amount, as in the cases of which we spoke earlier



At 11 o'clock: May 7
At 10½ o'clock: May 15.
At 10 o'clock May 22

At 9 o'clock June 7
At 8½ o'clock: June 14
At 8 o'clock June 22

At 9½ o'clock: May 30

The hours given are in Standard Time. When local summer time is in effect they must be made one hour later: 12 o'clock on May 7 etc.

NIGHT SKY MAY AND JUNE

Checking One Method Against Another

Suppose now that all our measurements of parallax are too large, on account of some unexplained error, by a fixed but unknown amount. The spectroscopic parallaxes, which are adjusted to match the direct measures, will then also be too large, but in this case the error will be greatest for the large parallaxes, and least for the small ones, so that the two sets of parallax determinations, though they agree on the average, will disagree, in opposite directions, for the large and small parallaxes, respectively In this way it is possible to detect such an error, if one exists, and even to determine its amount

Strömberg concludes that the spectroscopic parallaxes require corrections varying somewhat for the different spectral types, but amounting on the whole to an increase of 2½ per cent in their values, while the directly measured parallaxes measured by the various observers require corrections, some additions and some subtractions, but none exceeding 1/800 of a second of arc The average of the four longest series of observations (at the Yerkes, McCormick, Allegheny and Mount Wilson Observatories) is correct within a thousandth of a second.

This is a most gratifying conclusion, and shows that the means taken to avoid the introduction of error into the observations have been highly successful Our present determinations of stellar distance are amazingly accurate, when it is considered what minute quantities have to be measured For example, 1/800 of a second, *the largest correction found to be required, is equivalent* to the angle subtended by 1/100 of an inch at a distance of ten miles. For distances up to 100 light years, or rather beyond, our present direct methods of observation may be regarded as satisfactory, while the spectroscopic method, which is also thoroughly trustworthy, may be applied to a distance ten times as great

The Heavens

As our map shows, the winter constellations have quite vanished except for Gemini, which is setting in the northwest. Leo is still well up in the west and Virgo is high in the southwest—brightened by the presence of Jupiter and Saturn. Corvus, Crater and Hydra are below, the latter stretching parallel to the horizon through a whole quadrant of the heavens. Scorpio is rising in the southeast, and Centaurus is on the meridian Only the northern part of this constellation is visible in our latitude but observers in the tropics can see, at this season its two brightest stars, low on the horizon Boötes is overhead and Ophiuchus and Serpens occupy most of the southeast Hercules and Corona are high in the east Lower down Cygnus and Aquila have just risen, with Lyra above the former Cepheus and Cassiopeia are low in the north, while Ursa Minor and Draco are higher, above the Pole, and Ursa Major higher still, northwest of the zenith

The Planets

Mercury is an evening star this month and is unusually well placed for observation around the 23rd when he is at his greatest elongation, 22½° from the sun and more than 25° north of the celestial equator He is in the constellation Taurus, and appears as bright as Capella or Procyon, remaining in sight until 9 P M

Venus is an evening star, a little higher in the sky than Mercury, and about forty times brighter During the latter part of the month Mercury will be within five or six degrees of Venus—below her and to the right—and will therefore be very easy to find, though the glare from Venus will tend to obscure his real brightness.

Mars is almost as far south of the equator as the other two planets are north, and therefore rises late, although he is nearing opposition By the end of the month, however, he puts in an appearance at 8 20 P M., and is conspicuous in the late evening He is in Sagittarius, moving slowly westward into Ophiuchus, and brightens steadily until he surpasses Sirius and almost equals Jupiter

Jupiter and Saturn are still close together in Virgo—the former being about 8° farther east—and are conspicuous until the small hours. The former sets at 2 30 A. M and the latter at 3 00 A. M in the middle of the month Uranus is in Aquarius, and rises at 2 A. M on the 15th Neptune is in Cancer, and sets a little after midnight on the same date.

The moon is in her first quarter at 8 A. M on the 4th, full at 1 A. M. on the 11th, in her last quarter at 1 P M. on the 18th, and new at the same hour on the 26th She is nearest the earth on the 8th, and farthest away on the 19th. During the month she is in conjunction with Neptune on the 4th, Saturn on the 7th, Jupiter on the 8th, Mars on the 18th, Uranus on the 20th, Mercury and Venus on the 26th—a pretty sight before dawn—and with Neptune again on the 31st.

Recently Patented Inventions

Brief Descriptions of Newly Invented Mechanical and Electrical Devices, Tools, Farm Implements, Etc.

Pertaining to Apparel

CAP.—L. KRONTHAL, 314 W 94th St., New York, N Y This invention relates to a cap which is so constructed as to be applicable to heads of various sizes. An object is to provide a cap construction which includes means of adjustment for limiting the radial expansion of the head receiving opening, and means cooperating therewith for holding the cap to snugly fit the head of the wearer

GARMENT MARKER.—A R PRICE, c/o Gebhardt Scudder & Hendrickson Spalding Bldg, Oregon City, Ore The object of the invention is to provide a device which is adapted to effectively mark the garment, which while demountable may be readily set up and accurately adjusted, and which is in general of simple and durable construction, reliable, easy and inexpensive to manufacture, and susceptible of advantageous use by a single operator

GUARD SOLE FOR SHOES—A M GLUCK, 948 Union Ave Bronx N Y The invention is designed primarily for use with bathing shoes, an object being to provide a guard sole which will protect the feet of the bather from pebbles or shells, and will serve to prolong the life of the shoe A further object is to provide a flexible guard sole, made of some metal, such as aluminum, which is light in weight and strong enough to be durable.

Chemical Processes

PROCESS FOR TANNING LEATHERS AND SKINS.—H MORIN, address J Bonnet Therion, 95 Boulevard Beaumarchais, Paris, France The invention relates to a process for white tanning leathers and skins. The process consists in the incorporation with the cells of the skins, whatever may be their origin and their nature, of silica or oxide of silicon which, combining with the constituent elements of the skin, forms with them an insoluble imputrescible composition

Electrical Devices

CONTROLLER FOR ELECTRIC MOTORS.—G E. ADAMS, 660 Maryland St, Gary, Ind More particularly the invention relates to manually operated controllers, used in starting direct current motors. The main object is to provide a device by means of which the starting resistance may be shorted out gradually as the motor comes up to speed, regardless of how fast the handle is thrown around, or regardless of what load the motor is required to start with or what the line voltage is.

Of Interest to Farmers

TRACK CONSTRUCTION—W W WHEELER, c/o St John Hotel Columbia, S C The invention relates particularly to a track construction especially designed for use in the system of planting, cultivating and gathering crops. The purpose is to provide a construction which is simple, inexpensive and extremely durable to withstand the weight and wear of machinery passing over the tracks during the planting, cultivating and harvesting of the crops.

CONVEYING APPARATUS.—C FREDRICKSON, 29 W Marshall St. Rice Lake, Wis. An object of the invention is to provide an apparatus which is especially adapted for the conveying of potatoes or other vegetables and fruit Another object is to provide a main conveyor with cross conveyors, removably connected thereto, and provide an arrangement of doors, controlling the passage of the potatoes or other articles from the main conveyor onto any of the branch conveyors.

Of General Interest

EYE-SHADE.—W K. MILNE, 251 56th St., Brooklyn, N Y The invention relates to protective devices for the eyes. The primary object is to produce a simple and cheap article which consists of independent shade members adapted to be respectively positioned to each eye and supported from the bridge of the nose. A further object is to produce a shade made from a single piece of semi transparent material which is light and which is sufficiently small to render the same capable of being worn beneath a pair of spectacles.

TROLLING SPOON—E. C SELLECK, 423 Corbett Ave, San Francisco Cal The object of the invention is to provide a spoon or spinner which may be easily and cheaply manufactured and which will be attractive to the fish. The spoon is used in the usual manner, a shank is formed by bending a length of wire to form two strands with supporting loops for the spoon and hooks, the center of the wire strands being wrapped with silk thread of a brilliant color to represent the body of an insect

THREAD AND IMPLEMENT HOLDER.—G M MYERS, JR. 635 King St., Charleston S C The invention relates to the art of crocheting or knitting An object is to provide a container of light material for holding balls or spools of crochet thread which will feed the thread out as used to prevent it from becoming tangled or knotted during the crocheting, knitting or sewing operations A further purpose is to provide a needle-holding means for securing the needle to the thread container and means for conveniently attaching the container to the person

DOUBLE-EXPOSURE AND BLANK FILM PREVENTING DEVICE FOR CAMERAS—H J FRIES 1010 No 11th St, Tacoma, Wash The general object of the invention is to provide a simple device which may be readily applied to the shutter mechanism of cameras now in use as well as to those at the time of manufacture for preventing a double exposure or blank film The device is so constructed that it serves as a reminder to the user that the film should be turned. It is of a durable and lasting form and may be manufactured at a low cost

CONVEYOR CONDUIT—J B BROWN address D H Hamilton, c/o Cross Country Bank Wynne Ark. The invention more particularly relates to a pneumatic conveyor conduit embodying adjustable telescopic sections. One of the principal objects is to provide a conduit so constructed and arranged that any possibility of the sections becoming jammed is effectively precluded, the sections being at all times easily and readily adjusted to vary the length of the conduit.

IRRIGATING VALVE—J A NICKOLAUS, Richland, Wash The purpose of this invention is to provide an irrigating valve which is so associated with the pipe line as to effect a perfect control of the water irrespective of its pressure in the pipe, and to allow the water to be emitted from the side of the pipe, thus preventing the wind from blowing the water off to the side of the rills while irrigating

MANHOLE FORM—F L. YOUNG 906 Pershing Ave San Antonio Texas This invention has for its object to provide a form for concrete structures, especially adapted for building manholes and other tubular bodies having restricted outlets wherein the form is composed of a series of sections so connected that they may be expanded to the desired diameter, and may be detached to permit their removal through a restricted opening

EYESHADE—W A. CARLETON Governor's Island, N Y Among the objects of the invention are to construct an eyeshade which will preclude "side glare," thus avoiding a common objection to devices of this nature, and to so construct the shield that it may be readily folded to permit of its being carried in the pocket or safely sent in an envelope by mail

SMOKING PIPE.—W CELEDA, 489 So 15th St., Newark, N J The invention relates particularly to a pipe having means to catch the nicotine and prevent direct passage to the mouth of the smoker The general object is to provide a nicotine chamber of ample proportion and so arranged as to insure the settling and deposit of the nicotine, and also to prevent the passage of saliva to the bowl as well as to cause the smoke to be cooled before passing to the mouthpiece.

PROCESS OR COPYING CAMERA—A FRUWIRTH 54 Hart St, Brooklyn, N Y The invention relates particularly to copying cameras used for enlarging or reducing purposes. One of the objects is to present a complete unit involving a number of attachments and scales for substantially automatically securing the proper enlargement and proper focus whereby a user may secure excellent results without the use of technical knowledge Another object is to construct the camera in such manner that wabbling or loose motion will be eliminated

SALES SLIP—R P PACKARD 702 So Oakes St., Tacoma, Wash An object of the invention is to provide a sales slip which is primarily designed to facilitate the tabulation upon an adding machine of the prices of articles which have been purchased and listed on the slip, by providing a slip having spaces so arranged that an adding machine may be conveniently used to tabulate the price of the articles so that the price will appear in the same space as the name of the article

RAT GUARD—W F KONIG, 5 Goodsell Place San Francisco Cal The primary object of the invention is to prevent any possibility of a rodent utilizing the hawser of a ship when the guard is in applied position A further object is to construct the device so that it shall be adjustable and may be applied to various sizes of hawsers A further object is the provision of a guard which may be applied to the hawser subsequent to the positioning of the latter between the vessel and dock.

BEDPAN—B MORFITY 107 So Haroin St Sumter S C The invention has for its object to provide a pan having a cushion of rubber or the like for engaging the body of the patient to prevent shock from the cold contact, and to cushion the pan in such a way that the cushion may be removed when desired.

FENCEPOST ATTACHMENT—P T BAILEY, P O Box 272 R F D No 2, Middletown, R I The invention relates more particularly to a construction or attachment for the top of fenceposts for giving an additional fence structure or giving an ornamental appearance to the complete fence The object is to provide an attachment which may be mounted on fenceposts of various types. A further object is to provide an attachment which may be bent at an angle of 45 or more or less as desired

FLY SWATTER—C G COE, 127 East 17th St Lawrence Kan The object of this invention is to provide a device adapted for connection with a closure of any character, as, for instance a screen door and controlled by the movements of the closure for operating the same The device is in the form of a wire screen frame which is so arranged that it strikes the door when opened killing any flies between the door and the frame

WINDOW—A P SCHOETTERMAN, Lake Park Iowa This invention relates to a window which is especially adapted for use as a sleeping porch or balcony window or basement window as it is substantially rain and water proof it is easily operable and particularly adapted to be associated with the construction of the building adjacent such parts. The device comprises a plurality of hinged sash sections closely nested to extend over a comparatively short distance laterally when opened

MILK COVER.—C W MCLEAN R F D No. 1, Shavertown N Y The general object of the invention is to provide a simple, inexpensive device capable of use in filtering milk into milk cans to cool the milk as it is discharged into the can A further object is to provide a device of this nature capable of ready and quick connection with, and disconnection from, a milk can

STREET INDICATOR—W L CLARKE, JR, 690 East Call St., Tallahassee Fla A purpose of this invention is to provide a street indicator which is operable by the controller lever of a car so that the motorman during manipulation of the controller as the car is passing from one street to another will automatically actuate the indicator to apprise the passengers of the name or number of the next street in advance and before the car has reached such street.

SIGN—J T DOOLEY and T NILAN, 213 Beach 118th St Rockaway Park, N Y The object of the invention is to provide a sign consisting of letters, numerals or characters more especially designed for use on the ground at railroad stations, cemeteries or other places to designate the place in a simple and ornamental manner Another object is to provide a practically indestructible sign which may be embellished with a filling of cement, mosaic, dry stone chips of various colors, pebbles, or soil in which grass flowers or plants may be grown

HIGHWAY TRACK.—C T ELDREDGE, 3750 24th St San Francisco, Calif Among the objects of the invention is to provide a steel track adapted to be fitted into a concrete road bed without causing the concrete surrounding it to chip and at the same time to fortify the concrete so that the whole will resist severe strains brought to bear on it, the track being grooved in such manner that the tire of an automobile will not slip on it.

WINDOW CONSTRUCTION—P BOLCOUN 494 Hudson St New York, N Y This invention has for its object to provide a pivoted window construction which is rigid compact efficient and at all times waterproof and will prevent a leakage at the joints particularly around the pivot point The various parts can be made of any suitable material but preferably of sheet metal.

WATCH CASING. S BRUNER, 64 Fulton St New York N Y The general object of the invention is to provide a watch casing in which the movement holder is enclosed and which has means for cooperating with the covers of the casing to hold the movement holder centrally spaced with respect to the covers when they are opened and means in conjunction with the movement holder to assist in the opening of the casing

STUDENTS BOOKHOLDER.—W COHEN 68 West 17th St Bayonne N J The invention relates particularly to a construction adapted for use by students, and has for an object to provide a device wherein one or a larger number of books may be held in a clamped or bound position A further object is to provide a holder to take the place of the usual straps or other carrying means and will act as a rack for supporting the books on a desk.

FOOD COMPOUND—J A LAWSON, 244 Kearney St., San Francisco Calif Among the objects of the invention is to provide a food compound which will act as a substitute for butter as well as shortening and like compounds. Broadly speaking the compound includes about 82 per cent oily or fatty substance combined with about 16 per cent cereal extract and 2 per cent salt with or without coloring or preservative or artificial flavoring

COMBINATION BABY CHAIR AND CRIB—R. H HOLMES 7 No Pryor St Atlanta Ga The object of the invention is to provide a baby chair or crib adapted for use either outdoors or indoors and to provide a support or frame for suspending the same which may be compactly folded for shipment or transportation The device may be easily carried from place to place or accommodated in an ordinary trunk

ATTACHMENT FOR PIPES AND CIGAR AND CIGARETTE HOLDERS—N B PANOFF 54 I 7th St Brooklyn N Y This invention relates more particularly to means for facilitating the cleaning of the stem Among the objects is to provide a lining adapted to be fitted in a stem having means for removably securing it in position in a manner that the removal of the lining from the stem and the cleaning of the same may be done with ease

ADJUSTABLE FOOTSTOOL.—M. WEINGARTEN c/o Loudon Shoe Co, 110 Duane St. New York, N Y An object of the invention is to provide a simple and efficient stool which can be readily disposed in a convenient place, under a chair, and out of the way, when not in use, but which

can be quickly adjusted in an operative usable position with reference to the chair or other support when it is desired to use it.

FERMENTING TANK.—W H. NOE, address James Dempsey 105 So Division St., Peekskill, N Y The invention relates to fermenting tanks more particularly intended for the fermentation of yeast, the foaming of which is particularly persistent, making it difficult to confine it to the tank and prevent its overflowing The general object is to provide a tank and appurtenances that will serve to confine the yeast or other fermenting material within limits.

SHIPPING CASE FOR CASKETS.—G B SEXTON, 150 Main St., Asbury Park, N J The principal object of this invention is to produce a case for shipping caskets which is capable of being collapsed for reshipment when empty, and will then occupy approximately one-quarter its original bulk. A further object is to provide means in the form of hasps and bolts, for securing the case in both its set up and collapsed conditions.

CHURN STAND —C A KIBBE, Terlton, Okla. The invention relates more particularly to a stand which is adapted to hold a churn or other receptacle An object is to provide a stand which may be clamped to a table or other support and is provided with hinged walls capable of forming a receptacle when in vertical position and adapted to be folded flat upon the base and occupy but a minimum of space for storage or shipment.

CHECK PROTECTOR.—J J O'BRIEN, address W S Shanahan, 44 Court St, Brooklyn, N Y The invention relates to a check protector which is small and simple in construction and may be carried in the user's pocket or form part of a writing implement The protector includes a stem, a toothed wheel, a housing adapted to enclose the wheel, and means cooperating with the stem and housing for effecting a longitudinal movement.

MIXING FAUCET —W MEIER, 1951 7th Ave., New York, N Y An object of this invention is to provide a hand-controlled faucet for mixing hot and cold water in which the flow and temperature of the water issuing from the faucet can be accurately controlled by a lever A further object is to provide a mixing faucet which is especially adapted for use on sinks or shower baths, and which may be easily disassembled should repairs be needed The same inventor has also been granted a patent on a Pedal Controlled Mixing Faucet, which is operable by a foot pedal, leaving the operator's hands free for other purposes.

LADDER.—F M DESAUSSURE, JR., c/o Peerless Folding Ladder Co, Greenville, S C The object of this invention is to provide a ladder that is rigid and safe in use, light, compact, easily extended to operative position and collapsed into small compass for storage or transport and withal presenting a ladder that is extremely strong irrespective of its weight and material of which it is made A further object is to provide means for locking the ladder in open or closed condition

REFRIGERATION SYSTEM —J B. LACY, P O Box 740, Victoria B C, Canada. Among the objects is to produce a circulation of air in rooms provided with refrigerating coils. An object is to provide a system having means for controlling the humidity or the relative amount of moisture in the air of the room, means being provided for giving ready access to the cooling pipes, so as to remove the frost deposit, or for inspection or repairs.

REINFORCED CONCRETE WALL CONSTRUCTION —G L RACKLE, 4372 E Boulevard, Cleveland, Ohio. The invention relates to a structure which is economical to manufacture, convenient to ship, speedily erected, and requiring a minimum amount of material to make a strong wall with a maximum amount of air space comprising a studding section disposed there between the studding section having recesses for the disposition of dowel pins of twisted metal held therein by cementitious material

CLASP —E R NEBELING, 472 Fulton St., Brooklyn N Y The invention pertains more particularly to separable fasteners for bracelets, necklaces and similar articles of jewelry. One of the objects is to provide a fastener securely held against accidental displacement when in the locked position A further object is to provide a device of this character with a minimum of moving parts.

HAIR CURLER.—J DE RUVO, 2783 Broadway, New York, N Y Among the objects of the invention is to provide a hair curler which may be utilized in connection with any length of hair—in fact, it may be applied to a head of hair of relatively short length to impart a wave or curl without injury to the hair The device is constructed to use electric heat as a medium for the curling, without any injury to the head or hair.

CHICKEN FEEDER.—J P REGO, 650 Magellan Ave, Honolulu, Territory of Hawaii. The invention has for its object to provide a device in the form of a hopper, wherein a casing is provided for the grain, and a closure for the same, normally closed, but adapted to be opened by the weight of the fowls as they mount upon a movable platform to approach the feeder

MOUSETRAP —C E. SPENCER, R. No. 1, Box 50 Ovalo, Texas. The invention contemplates the provision of a trap having a plurality of compartments, by which animals may be caught alive and which when initially set, will be subsequently reset each time an animal enters the same, thus obviating the usual attention required to traps which must be reset manually by the user for reuse

Hardware and Tools

WRENCH —W LER. BONNELL, Box 405, Chickasha, Okla The invention relates more particularly to a pipe and nut wrench. The object is to provide such a wrench structure whereby a lever means may be used in connection with a screw for advancing and retracting the movable jaw of the wrench It is a further object that the parts shall be few in number, strong, and positive in action

WOODWORKING TOOL.—F R. SHUGART, 1713 9th St., Sacramento, Calif The primary object of the invention is to provide a combination tool of simple construction which is formed of a single piece of metal and has three different cutting edges so arranged and constructed that the tool may be easily, conveniently and effectively used as a hatchet, an adz or a draw knife. The tool is properly balanced and may be easily changed from one use to another

Heating and Lighting

LAMP GLOBE PROTECTOR —H C GROH, 204 Belmont Ave., Newark, N J The invention relates to lamp globe protectors, for either oil or gas lamps, and has for its object to provide a simple device which can be readily attached to any type of lamp globe to protect the globe from the heat of the flame, the heat being diverted from coming in contact with the walls of the lamp globe by a heat-distributing medium which operates to effect the uniform distribution of heat throughout the device.

WATER HEATER.—J RICHARDSON, 710 Gillman St., West Berkeley, Calif The particular object of the invention is to utilize the heat contained in waste smoke for heating water and to provide a tank which in combination with a particularly constructed furnace is adapted to present a large heat absorbing surface to the smoke A further object is to provide means for supplying additional heat to the water in case the heat furnished by the waste smoke is not sufficient to bring the water promptly to the desired temperature

OIL BURNER.—W H SCHROFF and R A GOUDIE, address R. A. Goudie, 5407 Broadway, Chicago, Ill An object of the invention is to provide an oil burner having a fuel delivery tube adjustable toward and away from the discharge end of a nozzle in order to secure the proper mixture of fuel and air A further object is to provide a battery of oil burners in which means are provided to adjust or shut off the individual burners at will

OIL BURNER —G S CLYDE, 7 Pierpont St., Brooklyn, N Y An object of the invention is the construction of a device in which, without any extraneous apparatus, a vehicle is provided having fuel which will result in an intimate commingling, minute sub-division and even distribution of the particles of the same, at the same time supplying elements which will induce combustion to a point at which the flame produced will be entirely non-oxidizing.

Machines and Mechanical Devices

ORE MILL AND THE LIKE.—H. T WILEY, Bridgeport, Ore One of the principal objects of the invention is to provide a mill which may be used for various purposes, such as crushing quartz, or grinding grain, the construction being such that only slight variations in construction are necessary to adapt the mill to various uses, the crushing process being accomplished by the operation of a gravity-actuated crushing member arranged inside of a vertical rotating wheel carrying inclined plates against which the crushing member operates.

AUTOMATIC CHUCKING MACHINE.—H. A. SCHWARTZ, c/o Defiance Machine Works, Defiance, Ohio. This inventor has been granted two patents of a similar nature. They relate to metal working machines of the high speed production type, the object being to provide a machine arranged to automatically and successively carry out on a single casting or a pair of companion castings or other pieces of work a plurality of different tooling operations, such as drilling, face tapping, reaming, champering, countersinking, and the like, according to requirements and without the required changing of the position of the work in the work holder Another object is to enable a single, practically unskilled attendant to run the machine and take care of the work.

DRIP PAN FOR GAGE COCKS.—G C. GRANTIER, 16 Pearl St., Hornell, N Y The invention relates to drip pans provided on boilers beneath the gage cocks. One of the objects is to minimize the liability of the clogging of the pan by freezing or otherwise. A further object is to so construct the plan that with water or steam directed into the same from the cock, there may be produced a characteristic sound which will indicate the water conditions of the boiler

BUFFING OR POLISHING WHEEL.—A LEVETT, 125 W 12th St., New York, N Y The object of the invention is to provide a buffing or polishing wheel which is simple and durable, not liable to fray at the peripheral edge, and arranged to prevent the formation of unduly thick portions at the gathered in edge of the hub. Another object is to reinforce the material by the use of fibers, bristles, fine wire or other filaments.

WRIST PIN.—T G SAXTON, address P G Coleman, c/o International Piston Ring Co., 91 McKinley Ave, Brooklyn, N Y The invention relates to a wrist pin more particularly intended for use in connection with the association of connecting rods with pistons of an engine An object is the construction of a device of this nature in which the hammering and oval wear of the parts will be eliminated. A further object is to provide a pin which will automatically take up any play which may come into existence.

COUPLING —F A GIBSON, Box 185, Jupiter Fla. An important object is to provide a belt coupling having means whereby the same may be readily and conveniently attached to the ends of a belt in such manner that the ends are not mutilated or punctured A further object is to provide a coupling which will prevent accidental disconnection of the sections from the belt, but which may be readily disconnected when it is desired to shorten the belt or remove the same.

SPINDLE TIGHTENER.—J MATTSON, General Delivery, Chicago, Ill The invention particularly relates to a device for tightening and holding driven spindles in milling machines or the like, against longitudinal movement. An object is to provide a device having means for engaging with a spindle to adjust the latter relative to its bearings and to prevent longitudinal movement, without interfering with the functional movements thereof The device is self, adjusting, preventing play between relatively moving parts on account of wear

ORE JIG —E M DAUGHERTY, Tuberculosis Hospital, Webb City, Mo. A purpose of the invention is to provide a supplementary jig which may be incorporated in a jig of the Harz type, or formed independently of the same and associated with the discharge end thereof, such jig including a sieve disposed in a horizontal plane, whereby provision is made for the free and very nearly equal action of the ore bed throughout the length of the screen, and thereby providing for free settling conditions and higher ore recoveries.

THRESHING MACHINE.—R. HOLDEN, 412 W Mercury St., Butte, Mont. The invention relates to grain threshers and has reference more particularly to that portion of a grain separator carrying a threshing cylinder, the principal object being to provide one or more adjustable concaves for the threshing cylinder, which may be adjusted or set without moving the same from the separator

OIL LIFT.—W. C. CUSHING, 1110 So. Carson Ave., Tulsa, Okla. The prime object is to provide an automatic valve of the swab type which will not only permit the free flow of the oil from below to above the swab on the down stroke, but which will also permit free flow from above to below the swab on the up stroke of all oil above exceeding the capacity of the lift while automatically cutting off the flow and retaining all of the oil thereabove within the capacity of the lift.

RELEASING DEVICE FOR AIR BRAKES.—W. W. WOOD, c/o Hotel Lohr, Lafayette, Ind. The invention relates to braking mechanism of the combined hand and pneumatic operated type, a purpose being the provision of a brake mechanism which is operable to allow the spring of the brake cylinder to release all parts of the brake gearing after a brake application by hand or air without the piston of the brake cylinder being moved from its released position.

CUTTER FOR TRANSFER RINGS.—G T TWIDDY, 617 Parsonage St., Elizabeth City, N C More particularly the invention relates to cutting mechanism adapted for use with the transfer mechanism of a knitting machine. The device includes a cup and a rotatable transfer ring in said cup cutting mechanism carried by the cup arranged for removing the edge of the fabric carried by the transfer mechanism upon rotation of the transfer ring.

PUMP PISTON.—J E. EVANS, c/o B F. Green, Kerosene System Sales Co., Drew, Miss. An object of the invention is to provide a pump piston which is especially designed for use with air pumps, but which may be used for pumping any suitable fluid, which consists of few parts, which may be easily assembled, and at the same time prevent the air or fluid from escaping around the piston on the pressure stroke.

DRUM.—J E. W FOGAL, Quincy Elevator Gate Co., Quincy, Ill. Among the objects of the invention is to provide a drum which is so constructed as to cause its load to be moved slowly at the start, the speed of travel being gradually accelerated to attain a uniform maximum speed, and then gradually decelerated to a dead stop, the drum being rotated at a uniform speed during the entire time.

DRINK MIXER.—C. VOGT, 2410 Ogden Ave., Chicago, Ill. This invention has for its object to provide a drink mixer adapted to be actuated by water power, and provided with means arranged to be operated automatically to control the flow of water into engagement with a movable part of the device. A further object is to provide a water motor and conduit leading thereto and automatic means for controlling the flow of water through the conduit to the motor

ADJUSTABLE CHUTESPRING FOR TYPESETTING MACHINES.—R. SHIELDS, 500 Coney Island Ave., Brooklyn, N Y The invention relates to typesetting machines. Its main object is to provide means for mounting the chutespring on the assembler entrance plate to admit of vertical adjustments of the same, whereby matrices of various sizes may be accommodated between the assembler bucklers and the chutespring to minimize clogging and transposition in the line.

SNOW REMOVER.—S. QWAM, 840 72d St., Brooklyn, N Y Among the objects of the invention is to provide a snow removing machine mounted upon a motor vehicle and operated by the engine of the motor vehicle to remove the snow and deposit it in a second vehicle for conveying the snow to a point of dump. A further object is to provide a snow remover which will quickly move along the ground and automatically pick up the snow.

DRYING MACHINE.—N C HERO, 329 Tchoupitoulas St., New Orleans, La. This invention has for its object to provide a machine adapted for drying granular material of any character, wherein a series of coaxially arranged rotatable cylinders is provided, together with means for providing heated air and means for feeding the material into alternate compartments, the arrangement being such that the largest possible amount of heat is utilized in the drying.

FOOT VALVE FOR WELL CASINGS.—P B. TURPIN, JR., c/o Georgia Supply Co., Tampa, Fla. The primary object of the invention is to construct in such a manner that it may be removably and adjustably secured within a well casing. A further object is to provide a foot valve which, when positioned, provides an airtight joint between the body of the valve and the well casing, thus greatly increasing efficiency.

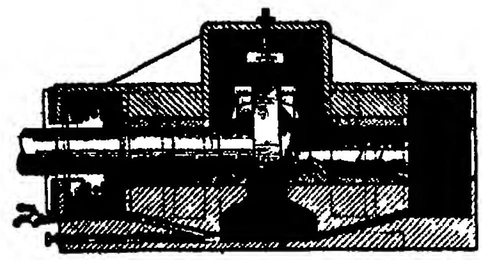


Fig. 1. Oil guide and dust protector invented by A. W Minney

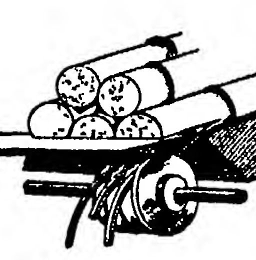


Fig 2 Bamboo-shredding machine patented by A. H Williams

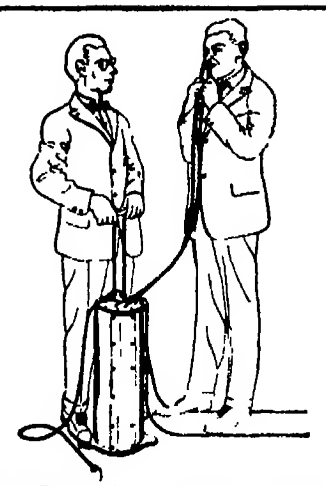


Fig 3. The respiratory apparatus designed by G. Anston

WELDING TABLE.—J MURCHIE, 244 E. 8th St., Traverse City, Mich. The invention has for its object to provide a table of the character specified, especially adapted for oxyacetylene welding, wherein the table is so mounted that it may be inclined at any desired angle, with either face upward, and may be held in adjusted position without the possibility of accidental displacement.

TENSION DEVICE FOR SPOOLERS.—D E. SKEDGELL, 5 Cliff St., North Tiverton, R. I. This invention relates to tension devices, and pertains more particularly to tension devices adapted for use on machines or other structures for spooling yarns. It is an object to so construct the device that as the strain upon the yarn increases the tension of the device is reduced

WINDMILL.—A. J CROWLEY, Box 393, Clayton, New Mexico. An object of the invention is to provide a device employing a plurality of vanes arranged to be operated by the force of the wind and their relative positions controlled thereby, as well as by manually operable means, whereby the wind mill is operated at maximum efficiency under varying wind conditions.

LIFTING DEVICE.—J JOLLY, 2008 8th St. W, Hutchinson, Kan The invention relates to a mechanical device particularly adapted for removing plates or sections from a storage battery An object is to provide a device by which a section of a storage battery including the usual positive plate assembly may be lifted from the battery jar without injury to the plates.

FILM CLEANING AND POLISHING MACHINE.—C. R. CARLETON, c/o Duplex Machine Co., 816 75th St., Brooklyn, N Y Among the objects is to provide a machine for treating strips of material, and more particularly for polishing and cleaning continuous strips of motion picture films. The primary object is to produce a machine of this character which may be used for polishing newly-made films or for cleaning old or used films, particularly the emulsion side, without injury to the sensitized surface.

OIL GUIDE AND DUST PROTECTOR.—A. W MINNEY, 231 E. Fremont St., Stockton, Calif. The invention has for its object to provide oil guides and dust protectors for bearings, and a bearing which may be packed with lubricant to provide for continuous lubrication, and which is so arranged that the oil cannot escape from the bearing. The device is adapted for use in any connection where it is desired to lubricate a bearing and prevent the entrance of dust, as, for instance, in saw, or flouring mills. (See Fig. 1.)

MEANS FOR CUTTING KERF IN MINING.—J M. CHRISTINE, 1157 6th Ave., Ford City, Pa. This invention relates generally to the mining of minerals, and, more particularly, to means of cutting kerp with the chain-cutters of mining machines. The primary object is to provide a device which may be adapted to practically any type of mining machine now in use, whereby the kerp may be cut with more efficient results.

GRINDSTONE MOUNTING —W. E. HOLMQUIST, Spokane, Wash. The object of the invention is to provide a mounting for grindstones, such as are used for pulp mills and other establishments, and arranged to steadily hold the grindstone in position on the shaft or spindle and to allow of conveniently and quickly releasing and removing a worn stone without breaking it up, and replacing the same by a new one, thereby permitting the reusing of the worn stone in a mill requiring a stone of less diameter

DOOR OPENING MECHANISM FOR ELEVATORS—H L. BRAYTON 225 S Howell St., Owosso, Mich. An object of the invention is to provide a door opening mechanism which can automatically, simply and efficiently, be actuated by the operator of the elevator Another object is to provide means whereby, when this appliance is used in connection with high-speed elevators the operating parts are not injured by the shock or contact between the elevator and the operating parts.

DISHWASHING MACHINE — C. E. WING 424 College Ave, College Point, N Y One of the objects of the invention is to provide a machine for washing dishes in which washing fluid and rinsing fluid may be separately used A further object is to provide means for separately introducing the washing fluid and rinsing fluid to the washing chamber, and mechanism whereby the dishes being washed are subjected to a spray of washing fluid from all angles.

BOTTLE-CRATING MACHINE.—P K COOK, 319 Mountain Ave, S W, Roanoke, Va. Among the foremost objects of the invention is to provide a machine for placing bottles of any of the ordinary shapes into a sub-divided crate or container, either ends up or down A further object is to provide a crating machine which advances a crate step by step so as to receive a charge of bottles at each step, and to provide means for automatically stopping the machine

COMBINED CRUSHER AND MILL.—H LOEVEN, 800 10th St. Douglas Arizona. A purpose of this invention is the provision of a combined crusher and mill which is constructed to automatically effect the return of over-size ore to the mill so as to cause a further reduction of the ore to the required degree of fineness in a single, continuous operation.

TRANSMISSION —H. BUSH, R. F D No 2, Linnton, Oregon This invention relates generally to power transmission and more particularly to a transmission for wave motors The object is to provide a gear mechanism adapted to receive driving power from two different sources, to combine the two powers into one and then transmit it as a single power to the machinery which it is desired to drive.

OIL SEPARATOR.—E. J BEACH, 55 Green St, Brooklyn, N Y The object of the invention is to provide an oil and air separator especially adapted for use in connection with compressors, the arrangement being such that the sealing oil in the compressor is relieved from its air without interrupting the compressing or without necessitating the use of a large amount of oil A further object is the provision of a baffle and a straining member, arranged in such manner as to permit the passage of air without appreciable back pressure while causing a thorough separation of the air and oil.

MACHINE FOR SHREDDING BAMBOO AND THE LIKE.—A H WILLIAMS, Plant City, Fla. The invention particularly relates to a machine for the shredding of bamboo from which brooms and other articles are to be made. A further object is the provision of a machine which in one operation will make straws out of which the brooms are to be manufactured, and wherein the bamboo or similar material is shredded by reciprocating lengths thereof over suitably arranged means for accomplishing this purpose. (See Fig 2.)

COTTON CLEANER AND SEPARATOR.—C HILLMAN and S SIMMS, Box 234 Runge Texas. The object of the invention is to provide a device wherein all dirt, trash and the like is separated from the cotton by means of suction, the cotton being fed to the machine in a light, flocculent mass, which permits all dust and the like to be thoroughly separated from the cotton, and without twisting or tangling the cotton and without converting it into short staple by tearing the fibers

PUMP VALVE.—W J NOTT, Franklin Terrace West Croydon South Australia Australia. This invention relates to pumps for lifting water and other liquids According to the invention the valve seatings, that of the foot valve and the plunger valve in stead of being square across the barrel of the pump, are formed obliquely thereto and in addition the plunger is fitted immediately below the valve with two bucket leathers, one above the other, each being held in place by a back nut

MOTION PICTURE APPARATUS.—O ANTONELLI, 108 Bay 49th St., Brooklyn, N Y The aim of this invention is to provide a motion picture apparatus which is extremely simple, and in which one unit shall be capable of taking as well as projecting the pictures. An object is to combine the essential parts of this apparatus in such way that they will function for the purposes of both photography and projection, thus reducing the initial cost as well as the subsequent expense to a minimum

SAFETY SHUTTER FOR MOVING PICTURE APPARATUS—B L. YOUNG, 1913 N Second St, St. Joseph, Mo. An object of the invention is to provide a screen shutter unit which, during its operation, protects the film by intercepting a substantial percentage of the heat in the light rays striking the film while at the same time permitting a proper amount of light to pass to the film. Another object is to provide a shutter unit which can be readily assembled and adjusted

TYPOGRAPHICAL MACHINE.—L. C TINSLEY, 1975 Creston Ave., New York, N Y The object of the invention is to provide means for compressing a line of matrices, and measuring the length of such compressed line in the assembler elevator of the machine, and also indicate the length of the space to be filled. The device is particularly adapted for use in setting up tabular matter, and may be used with columns of any width

ADJUSTING MECHANISM FOR THE BREAKING ROLLERS OF FLAX BREAKING MACHINES — I ETRICH Oberaltstadt, near Trautenau, Bohemia The invention relates to a means to simultaneously adjust the fluted breaking rollers of a large number of pairs of rollers. The invention particularly provides a means whereby the distance between the plurality of pairs of rollers may be adjusted in a predetermined ratio, and thus differentially adjust the several pairs.

FLOOR OILING MACHINE.—A. WENGER, 432 Broadway, Bayonne, N J One of the principal objects of the invention is to provide a simple means for effecting an equal distribution of oil over the surface to be coated A further object is the provision of means for regulating the flow of oil to an applicator member, and includes a plurality of interchangeable polishers and finishers capable of association therewith for various purposes.

APPARATUS FOR COOLING LARD, ETC—C S HARDY, 710-722 6th St., San Diego, Calif. The invention relates to methods and apparatus designed for cooling melted lard as it comes from the tanks or kettles in the factories, and more particularly to an apparatus for cooling and mixing of fats of compound lards composed of animal and vegetable fats, in a uniformly homogeneous product

CHANGEABLE EXHIBITOR.—T L. EASLEY, c/o Travelers Hotel, San Antonio, Texas. An object of the invention is the provision of an illuminated, changeable exhibition in which the arrangement of the reels and web is such that the number of signs which are successfully and intermittently displayed is materially increased without appreciably increasing the number of parts of the mechanism

SCUTCHING MACHINE.—I ETRICH, Oberaltstadt, near Trautenau, Bohemia This invention relates to the scutching or beating and bending operation to which flax is subjected following its passage through the breaking machine The patent provides an assemblage whereby the flax is subjected to successive scutching operations and treated alternately at each end with a view to effect a more complete scutching

DRIVING MEANS FOR SPRING MOTORS—A V WILSON Bar Harbor, Maine. An object of the invention is to provide a motor including a power spring, which is adapted to drive a power shaft, and which is arranged to be rewound either continuously or intermittently by a coacting strike plate and lever arrangement, which may be so disposed in a floor that persons walking across the strike-plate will cause the automatic rewinding of the spring

Medical Devices

DENTAL IMPRESSION TRAY —V M. ROBINSON P & S Building, St Joseph, Mo The invention relates to an impression tray especially adapted for taking partial impressions its object is to provide a device adapted to the varied requirements of individual cases, and in difficult cases wherein the tooth is undercut or has a bulbous crown and which in all cases is effective to secure a distinct, clean-cut and true impression

RESPIRATORY APPARATUS —G ANSTON 937 Belmont Ave., Chicago, Ill The invention relates to medical or curative apparatus, for bringing about a thorough and effective circulation of blood and nerve fluid of the body and brain by first drawing out of the body impure air and forcing clean, fresh air into the body The object is to provide a simple apparatus which may be efficiently utilized in home or self treatment, beneficial results being obtained with little trouble or loss of time. (See Fig. 3.)

Musical Devices

PHONOGRAPH RECORD CLEANING ATTACHMENT.—J. Runk, 235 S. Main St., Stillwater, Minn. An object of the invention is to provide a device arranged to be attached to the tone-arm in advance of the reproducer needle, so as to move over the sound grooves ahead of the needle to wipe out accumulations of dust from the grooves and insure a clearer and more faithful reproduction of a recorded sound wave. A further object is to provide a device made either in the form of a brush or from a fabric of velvet, silk or other suitable material.

SOUND-MODIFYING DEVICE FOR PHONOGRAPHS.—J. R. Parrish, c/o Nashville Blue Print & Supply Co., 8th floor, Life and Casualty Bldg., Nashville, Tenn. The object of the invention is to provide a device which may be easily and expeditiously attached to the needle holder of a phonograph without changing the construction thereof, and when attached is adapted to soften and lower the volume of sound waves produced by the instrument. The device will in no way impair the clearness of the musical sounds.

Prime Movers and Their Accessories

INTERNAL COMBUSTION MOTOR.—J. T. Cook, 550 Central Ave., Newark, N. J. The invention relates more particularly to motors commonly known as the two-cycle type. One of the objects of the invention is to provide a motor of the two-cycle type in which the cylinder is cleared of burnt gases by introducing the fresh charge thereto under pressure. A further object is to so construct the motor that no valve driving mechanism is employed, and that the several parts may be easily disassembled when necessary.

CARBURETING BURNER.—E. P. Herpin, Box 845, DeQuincy, La. The object of the invention is the provision of a burner including as a part thereof a combustion chamber and means for thoroughly carbureting the fuel and especially one in which provision is made for the primary combustion of the fuel, secondary combustion of which takes place in the space to be heated, with which the burner is connected.

CIRCUIT CONTROLLER FOR IGNITION SYSTEMS.—J. H. Stearns, c/o Washington Missionary College, Tacoma Park, D. C. The invention relates generally to an apparatus for controlling the ignition system of an internal combustion engine, and particularly to a circuit controller which is governed by the lubricating system of an engine for automatically distributing the ignition system and giving a visual indication when the oil in the system is insufficient to properly lubricate the engine.

PACKING GLAND.—L. R. Joyner, c/o L. S. Hass, Opelousas, La. An object of the invention is to provide a form of packing gland that is particularly adapted for application to a cylinder of an internal combustion engine. A further object is to provide a practical means for effecting a light between a cylinder and the parts associated therewith in such a manner as to permit such associated parts to satisfactorily perform the functions for which they are designed.

LOCK FOR INDUCTION COILS.—H. F. Maguire, 168 East End Ave., New York, N. Y. The object of the invention is to provide a combined testing and locking device for ignition systems, and is especially designed for use in connection with the ignition system of an internal combustion engine. An object is to render the function of all of the coils inactive whereby to provide in effect an anti-theft device in connection with a testing device.

HYDROMETER.—R. L. Campbell, 60 E. Chicago Ave., Chicago, Ill. Among the objects of the invention is to provide a hydrometer to be used with storage batteries which are charged by dynamos driven by internal combustion engines, the main purpose being to provide a hydrometer which indicates the amount of fuel to be used in the engine to run the dynamo for charging the battery to a predetermined point.

INTERNAL COMBUSTION ENGINE.—J. E. and T. R. Everett, Cochran, Ga. This invention relates to engines of the four-cycle type, its purpose is the provision of an engine in which the deterioration from wear of the work cylinder and work piston is materially reduced by the employment of means to receive the sideway thrusts, and to relieve the work cylinder and piston of all duty except that of performing the operations of the cylinder, whereby trouble resulting from leakage past the piston is eliminated.

ROTARY ENGINE.—A. J. Anderson, 553 Atlantic Ave., Brooklyn, N. Y. Among the objects of the invention is to provide an engine in which there is a rotor having one or more abutments formed integral therewith or rigidly secured thereto, there being provided means to admit the expansive medium in predetermined quantities at the desired moment with respect to the position of the abutments, the entire structure being simple, compact and well balanced.

Railways and Their Accessories

FREIGHT CAR DOOR.—J. Lyons, c/o Edlund, R. 9 Union Depot, Ogden, Utah. Among the objects is to provide a door which will buckle when the car bulges and at all times conform to the shape of the side wall of the car so that it will not jam when the box car becomes old and gets out of shape. A further object is to provide a track upon which the door slides, and a housing for the track which will effectively protect the same from dampness in inclement weather.

CAR WHEEL RERAILING BLOCK.—W. Matney, Box 100 Stone City, Ky. The object of the invention is to provide a pair of blocks whereby a derailed car may be replaced upon the track. The device consists of an outside and an inside block, a guide-rib on the top surface of each block adapted to cooperate with the flanges of the car wheels to guide the wheels toward the rails and a tiltable platform on the top of the outside block adapted to rest upon the adjacent rail.

TROLLEY WHEEL.—E. T. Thayer, Box 668, Charleston, West Va. An object of the invention is to provide a trolley wheel which is durable in construction, smooth and even running in operation and easy and inexpensive to manufacture. A further object is to provide a wheel which is so organized as to possess in assembly all the features of a unitary construction and at the same time provide for easy removal and replacement for repair.

Pertaining to Recreation

TOY.—H. Manes, 441 E. 187th St., New York, N. Y. The invention relates to gyroscopic aerial tops. An object is to provide an attractive toy for playing various games in which one or more persons may enjoy the sport, and in which the qualities of skill, judgment and luck play proportionate parts in the operation of the same.

CAR FOR PLEASURE RAILWAYS.—H. E. Riehl, c/o H. E. Tudor, 35 Hawthorne St., Brooklyn, N. Y. Among the objects of the invention is to provide a pleasure railway car comprising a truck, a car body, a pivot pin connecting the car body with the truck, the truck and the car body having annular concentric grooves and tongues one engaging the other, the center of the grooves and tongues coinciding with the axis of the pivot pin.

DRAFT MEANS FOR THE CARS OF PLEASURE VEHICLES.—H. E. Riehl, c/o H. E. Tudor, 35 Hawthorne St., Brooklyn, N. Y. The invention relates to amusement apparatus for use in pleasure resorts. An object is to provide means adapted to be engaged by the traveling chain for carrying the car to the top of the up-track, and means for preventing shock with the engagement of the chain with the draft means.

AMUSEMENT DEVICE.—W. C. Hadley, 3 East 43d St., New York, N. Y. This inventor has been granted three patents of a similar nature for amusement devices to be used in connection with automatic or self-playing pianos. The objects are to provide a plurality of heads of persons or animals which are so constructed that when placed upon the white keys of a piano the movement of keys raises and permits the lowering of the tongues so as to simulate the opening of the mouths. A further object is to combine with such pictorial representations a separate base member provided with independent flaps which may be positioned under the heads over the white keys.

JUVENILE BLOCKS.—W. C. Hadley, 3 East 43d St., New York, N. Y. The invention relates to blocks which can not only be used in the manner in which such blocks are commonly used, but also may be used in combination with a self-playing or automatic piano. The object is to provide blocks having upon their surfaces a picture of the upper part of a head, either of a person or an animal, which when placed upon the white keys of a piano, one of the keys will simulate the lower jaws of the head, and as it rises and falls give the impression that the head is opening and closing its mouth.

TOY.—W. C. Hadley, 3 East 43d St., New York, N. Y. The object of this invention is to produce a toy which may be positioned over the white keys of a self-playing or automatic piano and as the keys move up and down, the toy will operate to simulate a dancing figure.

AMUSEMENT APPARATUS.—F. H. Chester, 312 W. 93d St., New York, N. Y. The object of this invention is to provide an amusement apparatus for use in pleasure resorts, exhibition grounds, fairs and like places, and arranged to enable a number of players to participate at the same time and with equal chance of all the players to successfully play the game in the shortest time. The game consists of mechanically inflating toy balloons under air pressure until the first one bursts, thus finishing the game.

AMUSEMENT DEVICE.—H. E. K. Hingsmith, c/o General Delivery, Miles City, Mont. The invention relates to a pleasure railway, commonly known as a "loop-the-loop." The object is to so construct a pleasure railway with a safety device that any possibility of the vehicle carrying the passengers leaving the track and resulting in an accident is precluded.

TOY.—L. Hinz, 334 Rector St., Perth Amboy, N. J. The invention relates to a miniature representation of a flying machine or other moving object with spring motor means for revolving the miniature on a plane around a vertical axis. The device is durable, of simple construction and readily operable by children, and is adapted to furnish a high degree of amusement without liability of injury.

AMUSEMENT DEVICE.—G. C. Weiss, Box 148, Oakland, Calif. This invention has reference to a playing board on which the alphabet and other indicating characters are written, and a pointer which, when the fingers of one or more persons are lightly rested thereon, will move without conscious volition or effort, and develop mediumistic messages by means of the pointer cooperating with the indicating characters on the board.

Pertaining to Vehicles

COMBINED WAGON AND AUTOMOBILE TRUCK DUMPING AND WEIGHING PLATFORM.—J. Meyer and F. J. Manseau, 529 Mall St., Portland, Ore. An object of the invention is the provision of an apparatus which is entirely self-contained in the sense that it eliminates the necessity of making any connections in the mechanism or parts either before or after weighing, and a further object is the provision of an apparatus which may be controlled and actuated through the simple operation of a readily reversible electric motor.

TRACK.—G. Kunkle, 125 Grand Ave., Grand Junction, Colo. This invention relates to tracks for vehicles, which will eliminate the necessity of building expensive roads in inaccessible places. An object is to provide a track which is made in sections which will conveniently accommodate motor vehicles, and which can be quickly laid down or taken up. A further object is to provide a track which is useful as a traffic link in regions occupied by industries such as mining or lumbering, or for elevated traffic in congested cities.

SIGNAL LAMP.—E. S. Robinson, 810 Lincoln St., Oroville, Calif. The primary object of the invention is to provide a readily adjustable lamp for automobiles and motor cars in connection with readily and easily operable means for adjusting the same so that a signal may be given to other vehicles at turning or stopping points.

DISTRIBUTOR.—J. F. Armatees, c/o Plymouth Auto and Supply Co., Plymouth, Pa. The invention relates to automobile ignition systems and more particularly to an ignition distributor for Ford automobiles, which will avoid the use of individual vibrators in the high tension connections and will permit of the use of a single vibrating coil so that the disadvantages due to lag in the usual individual vibrators will be avoided.

CHAIN APPLICATOR.—D. Q. Farran, Rowan, Iowa. The invention relates to a device for attaching anti-skid chains in position upon the rear wheels of an automobile without leaving the driver's seat or without stopping the car, without touching the chain or applying the same by hand in the usual way, the chains for both rear wheels being simultaneously applied or removed as desired.

WHEEL.—C. B. [illegible], Box [illegible], [illegible], La. The invention has for its object to provide a wheel especially adapted for use with automobiles, but capable of use in any vehicle, wherein the resiliency of a pneumatic tired wheel is obtained without the liability to puncture or other injury, the resiliency being provided by telescoping spokes which are normally spring supported.

TIRE ARMOR.—J. Plum, 196 Hewett St., Bridgeport, Conn. The invention has particular reference to a protective armor including a plurality of sections adapted to be associated with tires for rendering the same puncture-proof, and eliminating to a large extent wear on the tread surface. It also further functions to prevent skidding and to provide an effective tractive surface. The device is circumferentially adjustable, rendering it applicable to tires of various sizes.

DIFFERENTIAL TRANSMISSION GEARING.—P. V. Troupe, Central Y. M. C. A., Moline, Ill. The invention has for its object to provide a differential unit so constructed that a greater percentage of the engine power is available for driving the vehicle, and in which the stresses and strains, due to the transmission of power therethrough, are uniformly balanced so that the wear on the unit is reduced and its life correspondingly increased.

HYDROMETER.—W. E. Dierow, Box 154, Lankershire, Calif. The invention relates in general to hydrometers, and more particularly to a hydrometer adapted for use in testing storage batteries of automobiles. The object is to provide a hydrometer which is a non-conductor, which will not be rendered inaccurate by virtue of variations in temperature and which will be always available to accurately test the storage batteries of automobiles.

ROAD INDICATOR.—J. Campbell, 8214 Prospect Ave., Cleveland, Ohio. An object of the invention is to provide a road map in the form of a strip wound upon reels and to provide means for automatically exposing that part of the strip which indicates the particular road over which the vehicle is passing, and also indicates the direction to be taken when cross-roads are reached. The device may be conveniently mounted on the dashboard of an automobile.

DIFFERENTIAL GEARING.—F. H. Crawford, c/o First National Bank, York, Neb. It is the purpose of this invention to provide a differential gearing which automatically limits its scope of differentiation, neither preventing or allowing of complete differentiation so that power is supplied to both wheels at all times. The invention allows of maximum differentiation, yet prohibits any greater differentiation, while at the same time permitting either wheel to act anywhere between the ratio of 5.5 while the other wheel is compensating from 5.5.

TRACTOR WHEEL AND SCRAPER.—F. P. Arnold, R.F.D. No. 3, Watkins, Minn. The general object of the invention is to provide a wheel presenting a duplex head with an annular clearance space between the individual treads. A scraper is arranged to coact with the duplex treads to yield to the pressure of a stone or other hard substance if wedged in the wheel and turning therewith.

RADIATOR.—A. Bertagne, 513 Main St., Wakefield, Mass. The invention relates to radiators of the type used in connection with motor vehicles, the object is to provide a radiator formed from sections independent of each other, and connected with common collectors or manifolds and so arranged that any section may be cut out from the circulation and removed without affecting the remaining sections.

CHILD'S VEHICLE.—C. Sollima, 13 Rue des Abbesses, Paris, France. The invention relates to a child's vehicle, consisting of an apparatus more generally known as "patinette," in which there is provided a propelling mechanism comprising two driving pedals connected through a convenient gearing with the rear axle of the apparatus, so as to permit of the propulsion of the vehicle without having to bring the feet into contact with the ground.

TANK.—A. [illegible], P.O. Box 1094, Casper, Wyo. An object of the invention is to provide a tank adapted to contain liquids and which is mounted on an automobile truck. A further object is to utilize otherwise lost space for hauling fuel, oil or other liquid, which need not be removed in hauling freight other than fuel, which can be built in any desirable shape and which [illegible] means for hauling the liquid in said [illegible]

[illegible] GEAR.—A. Hansen, 1262 [illegible] N. Y. The general object [illegible] steering gear for motor [illegible] in which the cable runs endlessly [illegible] the quadrant and through the cable-[illegible] means operated by the steering-post and is adapted to be shifted to take the worn portion away from a point of severe wear and present to the wearing point an unworn portion of the cable, thereby materially prolonging the life of the cable.

STEERING DEVICE AND BRAKE FOR TRACTORS.—O. L. Lewis, 836 W 60th St., Chicago, Ill This invention is applicable to any machine of a nature permitting of controlling the direction of movement of the vehicle by disconnecting the source of power from the wheel or wheels at one side while those at the other side continue to rotate under power. The primary object is the provision of a simple and convenient mechanism capable of control by flexible lines in the hands of the operator, and is applicable to various types of tractors.

TRACTOR STEERING AND CONTROLLING DEVICE.—H. P. Hamer, R.F.D. No. 1, Spring Valley, Ill. An object of this invention is to provide a device having means connecting with the steering mechanism of a tractor for guiding the latter from a trailer and having additional means for controlling the clutch mechanism of the tractor from the trailer A further object is to provide means connecting with the steering mechanism of a tractor to hold the wheels in normal position to insure travel of the vehicle in a straight direction.

ADJUSTABLE STEERING WHEEL.—V W Page, 309 Lafayette St., New York, N. Y. The primary object of this invention is to provide means whereby the steering wheel of a motor vehicle may be angularly disposed with relation to the driver's seat. A further object is to so construct the mechanism that the steering post is locked and thereby maintained in its adjustable position.

DIRECTION INDICATOR.—A. F Lamb, 244 Beach 81st St., Rockaway Beach, N Y The invention contemplates the provision of a device which will effectively indicate the intention of the driver to turn or stop following traffic. One of the principal objects is to provide a simple, inexpensive and compact indicator which is applicable to any standard form of vehicle now in use, and one which is located within convenient reach of the operator.

LOCK FOR SPARE RIMS AND TIRES.—E. H. Benedick, address E. E. Kincade, Box 121, Huntington, W Va. The invention relates to a device for locking a spare rim and tire to the bracket or carrier positioned at the side or rear of a vehicle for carrying such spare parts and more particularly for a lock therefor adapted to prevent a straight side rim or a clincher rim upon which is mounted a tire casing from being lost from the bracket or removed by an unauthorized person.

PET-COCK OPENING AND CLOSING DEVICE.—J H. Rovan and A. M. Deligne, address W A Calvin, 2126 Polk St., San Francisco, Calif. While relating in general to accessories for automobiles, the invention refers more particularly to a tool for opening and closing pet-cocks which are ordinarily located in more or less inaccessible places on the motor of an automobile but which must be opened and closed at certain times. One of the objects is to provide a tool which may be manufactured at low cost, easily applied and capable of use with great efficiency

AUTOMOBILE REAR SIGNAL.—A. Davis, 105 Orient Way, Rutherford, N J This invention has for its object to provide a construction wherein signals will be provided and connected to the front part of the automobile in such way that the driver may indicate different conditions, to be seen from the rear, at any time. Another object is to provide signals for the rear of an automobile and operating mechanism therefor which is operable independently of the automobile mechanism but coacts therewith.

POWER TRANSMITTING DEVICE.—T J Weeks, c/o Weeks Motor Sales Co., Montgomery, Mo. An important object of the invention is to provide a power transmitting device having means whereby the power from a Fordson tractor may be transmitted to a binder so as to operate the binder when the bull wheel of the same cannot obtain traction with the ground. Another object is to provide a device which may be applied to the tractor without altering the construction of the same. (See Fig. 4.)

TRANSMISSION MECHANISM —E S Stowers and J W Scott, Bluefield, W Va. The invention relates to mechanism having means whereby the transmission gearing is temporarily disconnected from the driven and driving mechanisms during the interval when the speed changing mechanism is being operated, thereby preventing breakage by the accidental engagement of rapidly moving parts. The purpose is to provide mechanism which is automatically operable to bring the gears to a dead stop as soon as the speed changing mechanism is disconnected from the driving and driven mechanism. (See Fig. 5.)

SELF-LOADING VEHICLE —J B. von Canon, West End, N C This inventor has been granted two patents of a similar nature, their purpose being the provision of a loading vehicle of simple and compact construction which is in the form of an attachment whereby it is rendered applicable to motor trucks of standard construction for effecting a loading of the truck as it moves along over the material to be introduced into the vehicle The invention is particularly designed, although not necessarily, to the loading of motor trucks with road-making materials, such as gravel, sand, and the like.

SAFETY FOOT THROTTLE FOR AUTOMOBILES.—E. J Currier, 601 Chester Ave., Ottumwa, Iowa. The object of the invention is to provide a convenient, safe and effective arrangement controlling the supply of gas to the intake of the motor As applied to a Ford automobile certain other advantages result, including the adaptability of the foot control to the opening of the throttle beyond the point at which the hand lever may be set, and the automatic return to the hand set position whenever the foot control is released.

SPRING WHEEL.—J A. Livings, 2318 Congress Ave., Houston, Texas. The purpose of this invention is to provide a wheel having resilient extensible spokes which support the hub in such manner that when the wheel is applied to the axle of a car, the car is resiliently suspended from the top of the wheel rim, whereby a resilient support is provided which absorbs and thus prevents transmission of vibrations from the wheel to the axle. It is also a purpose to provide a wheel having stabilizing means for preventing lateral movement of the rim or hub when the wheel is making sharp turns.

STOPPING DEVICE FOR STEERING APPARATUS.—P D Benbow and W E. Brock, 518 No. Liberty St., Winston-Salem, N C. The invention relates to a stopping device for limiting the movement of a steering apparatus of an automobile to prevent locking of the apparatus in one extreme position or the other, such locking being a common occurrence and causing accidents. The device is directly attached to the front axle and is adjustable to such point as to form an abutment on the spring arm of the steering apparatus to limit the movement.

TIRE MOUNTING.—L. J Perkins, Room 9, Beach Block, Lewiston, Idaho. The object of the invention is to provide a mounting of the character specified adapted for use in motor vehicles of any character, wherein the edges of the shoe or casing are so arranged that they may be pressed tightly together to seal the casing, and wherein means is provided in connection with the rim for securely clamping the edges together (See Fig. 6.)

SYSTEM AND APPARATUS FOR CONTROLLING MOTORS —A. K. Allison, 66 Webster St., Hartford, Conn. The object of the invention is to provide a compact and simple apparatus whereby the movements of a motor are definitely controlled, whether the motor is moving in one direction or another A further object is to provide a controller which is adapted to control the motor by a minimum number of operations, and to provide means whereby the movement is effectively braked at suitable intervals during the operation.

SIGNALING DEVICE FOR AUTOMOBILES.—A McLarey, 303 Putnam Ave, Brooklyn, N Y The object of the invention is to provide a signaling device for automobiles and other vehicles, arranged to signal to a following vehicle whether the automobile is going straight ahead or intends to turn either to the right or to the left An other object is to combine the usual tail light with the signaling device, and to permit the installation of the device with automobiles as now generally constructed.

SEGMENTAL CASING FOR TIRES — R. N Ink, 4627 Forty second St., San Diego, Calif. The invention relates to pneumatic tires, and a particular purpose is the provision of a tire casing supplemented to the ordinary tire casing and constructed in such form as to be superimposed thereon when the latter is unduly worn or punctured, and thus, in effect, provide a new casing It is also a purpose to provide such casing in a multiplicity of segmental sections, held so as to allow of ready removal of any one section independently

TRUCK ATTACHMENT FOR AUTOMOBILES —J Anderson, 504 S First St., Yakima, Wash The principal object of the invention is to provide an attachment that may be easily and quickly applied to the frame of a pleasure vehicle to convert the latter into a truck, as well as to provide for the ready removal of the attachment to restore the vehicle to its original character A more specific object is to so form the truck frame and its appurtenances as to stiffen and prevent sagging of the same or the frame of the chassis when the two are united.

ARMORED PNEUMATIC TIRE.—G M. Stivers, Dixon, Calif This invention relates more particularly to an armor construction involving readily removable or replaceable elements capable of forming a non-skid surface. An object is the provision of an arrangement which may be readily adapted to and removed from a pneumatic tire, which includes readily removable and renewable tractive elements which will be simple and inexpensive and durable and efficient in use.

GATE FOR DUMPING TRUCKS.—H Mecking, 1044 Hale Place, Bronx, N Y The object of the invention is to provide a gate for endwise dumping on automobile or power-driven trucks, or for sideways dumping on railroad cars, and arranged to insure an automatic opening of the gate on swinging the body into dumping position Another object is to prevent dirt from lodging in the joints, thus insuring free opening movement.

SHOCK ABSORBER FOR DRIVE SHAFTS.—A B. Manchester, 2412 Juliet St., Los Angeles, Calif Among the objects of the invention is to provide a shock absorbing mechanism which will serve as a cushion either between the transmission and the differential or between the engine and the transmission of an automobile driving mechanism, and which will prevent sudden strains and jerky motion of the car when the clutch is thrown in or the emergency brake applied.

MUFFLER.—H C and E. E. Emmons, No. Syracuse, N Y An object of this invention is to construct a muffler in which the gases will travel through a much greater length of channels than is the case in a conventional muffler, and will be so altered that the gases will merge in the form of a steady stream by reason of the twisting action imparted. A further object is the provision of a simple form of muffler which may be manufactured at a low cost.

MOTOR CAR.—A. Landini, Cameri, Italy The invention refers to a motor car of simple construction, in which the parts are so designed as to realize a substantial saving in weight and size, the whole portion of the carriage length heretofore allotted to the motor and radiator being saved without prejudicing the accessibility of the motor

Designs

DESIGN FOR A GAME BOARD —R. H. Cotter, 859 St. John's Place, Brooklyn N Y

DESIGN FOR A TOY BROOM.—R. Nakian, 207 Summit Ave., West Hoboken, N J

DESIGN FOR A LAPEL BUTTON ANCHOR.—W Fischer, 67 Cortlandt St., New York, N Y

DESIGN FOR A RADIATOR SHELL. —G S Duarte, 119 Mowbray Place, Kew Gardens, L I, N Y

DESIGN FOR A HOLDER FOR TOWELS AND OTHER ARTICLES — C A Michaels, 137 Pierson St., Jamaica, New York.

DESIGN FOR A CANDY CONE WITH STEM —J Goldberg, 226 Heral St., Brooklyn, N Y

DESIGN FOR A VALVE —O L Whiteman, c/o American Valve Co., Coxsackie, New York.

Fig. 4. Device for transmitting power from a [illegible], patented by T. J. Weeks

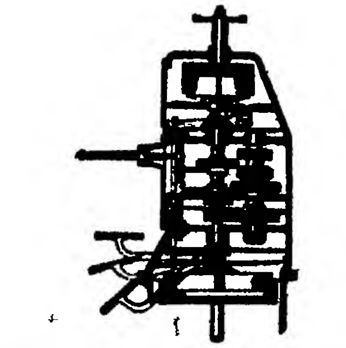


Fig. 5. Automobile transmission that avoids the risks of stripping gears in shifting, invented by E. S. Stowers and J. W. Scott

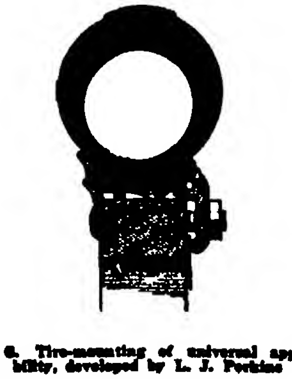


Fig. 6. Tire-mounting of universal applicability, developed by L. J. Perkins

Science Notes

Macmillan Reaches Baffin Land.—Continuous bad weather dogged the Macmillan party until they made the west coast of Baffin Land on August 15th, here they planned to establish winter quarters. Latitude and longitude differ so from the chart that they are impossible of identification; they agree with that of Jackman Sound, never found since Frobisher named it 345 years ago. No Eskimos had appeared when Macmillan wrote of his arrival. The Annapolis wireless time signals were heard every day

Yosemite Museum Relics.—This new Government museum already has a wonderful collection of Indian basketry, beautiful arrowheads chipped from volcanic glass, and an important geological exhibit. It has the only existing specimen of a Piute rabbit blanket, woven from strips of the tanned skins of many rabbits, then there is a soft, pliable water bottle, still usable despite its 200 years of age, woven in a stitch that is a lost art, a stitch so close that no resin was needed to make the bottle watertight. Letters written by John Muir are also numbered among the treasures.

Dessicated Vegetables.—When dehydrated raw vegetables are stored in airtight containers at ordinary temperatures investigations show that their moisture content is an important factor in their preservation There is a "critical moisture content" below which the distinctive color and taste is retained unimpaired for upward of six months. For cabbage this is from 3 to 3.34 per cent, for onions from 5.74 to 6.64 per cent. There is more injury from exposure to an atmosphere of comparatively high humidity at lower temperatures than from similar exposure in a dry atmosphere.

Insanity in Moving Pictures.—The leading character of a motion picture recently shown in the theaters of Paris is a man suffering from paretic dementia. The characteristic symptoms of the disease are developed on the screen in a masterly manner Delusions of grandeur, change of personality, and maniacal excitement lead on to murder and incarceration, and finally to death by apoplexy Undoubtedly an alienist was called in to supervise the depiction of these symptoms. The realism is intense, but from that very intensity objections are arising, with the warning that predisposed spectators may be hurried into a state similar to that portrayed by the chief actor

The Relationship of Absolute Magnitude to Space-Velocity.—A statistical study of the radial, tangential, and space-velocities of 1350 stars, mostly of types F, G, K, and M, reported in the *Astro-Physical Journal* by W S Adams, G Stromberg, and A H Joy, shows a marked correlation with absolute magnitudes. The results are given in the form of equations and tables. The increase in average space-velocity for a decrease of one magnitude in brightness varies with the type, but is of the order of 3 km/sec The greater homogeneity of the giant stars as a class and their comparative freedom from large individual motions are indicated by the results. As would be expected for a random distribution of velocities as to direction, the average radial velocities are about half the corresponding average space-velocities.

Mutual Influence of Fraunhofer Lines.—The dispersion theory of Fraunhofer lines, which assumes that the lines are almost entirely the effect of anomalous refraction and scattering, was developed by W. H. Julius some years ago and led to the prediction and discovery of the mutual influence of neighboring Fraunhofer lines for which conclusive evidence is presented in the paper The existence of this effect, not otherwise explained as yet, is considered by Julius to powerfully support this theory He concludes, in a recent article in the *Astro-Physical Journal*, that anomalous dispersion is a most effective, perhaps the only, cause of the entire limb-center shifts and must, therefore, also produce center-arc shifts. If so, the gravitational shift required by the general relativity theory may not exist. Of the 806 lines for which the limb-center shifts were measured at Mt. Wilson in 1910 or at Kokaikanal Observatory in 1914-16, 128 have close companions which may be expected on theoretical grounds to influence their position. A study of the observations shows that there is, without doubt, a mutual influence equal, on the average, to two-fifths of the normal limb-center shift, a companion on the violet side causing an increase, a companion on the red side a decrease, of the shift.

Miscellaneous Notes

No Artists Wanted.—Throughout Old Lyme and Hamburg Conn, you are welcome to wander over farm property—unless you are an artist. Signs everywhere forbid artists to trespass, the reason given is that many cows have been poisoned by paint encrusted rags thrown away by the colorists

Early History of Pleasure Travel—Traveling for pleasure came into vogue in the peaceful years of the Roman Empire Historic places and natural curiosities were sought out and famous groves and grottoes visited The Romans seem to have preferred these gentler aspects of nature and had little appreciation for towering heights and plunging canyons.

Toll of London's Fog.—The worst fog since 1902 visited London at the end of last November It is estimated to have cost the city $8 000 000 for each of the three days it lasted. Trains were delayed omnibuses tied up, and 60 laden vessels lay helpless off Gravesend while 20 miles away the sun shone brilliantly Health and property suffered alike, and six men were drowned by walking off piers This fog was due entirely to smoke, and a new campaign was launched by the Coal and Smoke Abatement Society with the object of having abatement measures passed

Giving Birds a Bad Name.—The Biological Survey warns us against charging the crimes of the English sparrow to other members of the sparrow family which although essentially seed-eating performs great service in its raids on insects Even jays crows, ravens and blackbirds, when not too numerous do about as much good as harm The best policy seems to be neither deliberately to persecute nor protect them The owl too has a bad name yet 50 varieties feed on rodents and have other useful habits, against which the occasional murder of a chicken is negligible

Chinese Buyers and Color Prejudices—The exporter to the Orient would do well to recognize the fact that the Chinese have strong prejudices as to the colors used in materials, wrappers and poster advertising often changing their patronage for no other reason In general red yellow gold bright brown purple and certain shades of pink are looked upon with favor white and blue are mourning colors, and green is associated with misfortune It is well to leave the designing of posters and the get up of advertising matter to agencies in China that are fully in touch with local tastes and superstitions.

Paper Dependent on Foreign Supply.—In 1920 two thirds of our newsprint was from wood grown on foreign soil We paid $191,000,000 for imported pulp wood wood pulp and paper and have become to this extent dependent upon markets beyond our control As the Forest Service pointedly states, we have mills without forests in the East and forests without mills in the West Alaska, with its generous growth of spruce and hemlock has but one mill All this means increased cost and high prices. Nor can Canada be looked to indefinitely as a source of supply The logical remedy is to build more mills on the Pacific slope while reforesting the East Skill money energy and time are demanded by this program but vastly higher penalties will follow our present indifference

Our Place in the Book World—The English speaking population of the British Empire is, according to the 1921 census 64 778 368 the population of the United States is 105 683,108 There are significant conclusions to be drawn from these figures which show us to exceed in numbers by about 60 per cent, all other English speaking peoples put together Since we are well in the van as to literacy and occupy the foremost place in the circulation of books through public libraries, it is not too much to expect that within a decade we may become the largest distributors of English language books Statistics are lacking as to the present book demands of different countries, but with the looked for extension of our library system we may hope to reach an additional 60 000 000 of our population What we do know is that in the per capita purchase of books we are steadily progressing—that new readers are constantly being added to the old army The importance of these developments, whether we regard books as trade products or from the higher ground as promoters of good understanding between peoples speaking the same language, can not be overestimated.

Civil Engineering Notes

The Simplon Tunnels.—When trains begin running through the new completely pierced second Simplon tunnel in January, the first tunnel, which parallels the second, will be closed for a time. The tremendous overhead pressure has weakened the roof which must be considerably reinforced. It is especially weak south of where the two tunnels join at the center, that is, on the Italian side.

Traffic Effect on Bridges.—The effect of every shock and blow delivered by moving vehicles in crossing a bridge is measured with scientific precision by a new instrument devised by the Bureau of Public Roads. Attached to the bridge structure this instrument makes a photographic record of the effect of the moving load. The device will greatly contribute to safety in building and maintaining bridges.

Tunnel vs. Airplane.—Several British dailies, as well as semi-scientific and technical organs, have been speculating recently on this topic, and expressing a more or less definite belief that the projected construction of a Channel tunnel might never be carried out because of the very strenuous competition which air transport would be in a position to offer by the time such a tunnel could be completed and got into operation.

Street-Car Routes in many of our large cities are largely the result of the same casual upgrowth that has determined the layout of the streets themselves. Few of our largest municipalities would fail to benefit from an engineering survey of these routes with a view of rearrangement. Such a survey was recently made in New York, and no layman can examine the recommendations of the committee without appreciating the improvement in service which would result from their adoption.

Newfoundland Water Power.—A total of 235,000 horsepower is estimated as the probable output of a project which comes from a rather surprising locality. The development is to be undertaken of the Humber Valley, Newfoundland, with the expenditure of $7,000,000 within the next two years. The power project is tied up with logging and other operations in a way which will involve the permanent employment of 1500 men in the works and 2000 more in the woods. The paper resources of the island will be very largely expanded by the new development, which is actually under contract at the present writing.

Wood Seasoning Investigations.—The air seasoning of wood is still in the rule-of-thumb stage, hence the experiments now being conducted by the Forest Products Laboratory in cooperation with sawmills and wood utilization plants to determine piling practice that shall result in the fastest drying rates consistent with least depreciation of stock, least amount of required yard space and lowest handling costs should settle the question whether lumber should be dried partly at the mill and partly at the utilization plant or completely dried at the mill, and also the comparative desirability of air-seasoning and kiln-drying.

Movements in Concrete Roads are of a surprising variety and a surprising amplitude, according to preliminary observations on the Pittsburg, Cal., experimental highway which is to be tested to destruction. Irregular longitudinal buckling or wave movement of the individual slabs occurs, with contraction cracks at the crests of these waves; warping of the cross section is far more pronounced than had ever been imagined, the edges cupping up at night and curling down in the daytime, and temperature differences are observed of as much as 7 degrees between top and bottom of the pavement, the top being of course colder in the morning and warmer in the afternoon.

The Snow Removal which was planned by several States for the purpose of keeping highways open during the past winter has been particularly effective throughout New Jersey and Pennsylvania. In the former State the very heavy snowfall of January 28-29 at no time led to blockade of the larger through routes, while Pennsylvania was able, with the exception of temporary local blockades due to serious drifting, to keep the entire Lincoln Highway open throughout the winter. New York City likewise was singularly successful in getting its streets quickly cleaned up after the few heavy snows that fell. Unemployment, combined with some very effective sweeps, plows, shovels and loading machines, were the chief means by which these results were effected.

Mechanical Engineering Notes

Cement Tile.—It is reported by one manufacturer [illegible] that over 50 000,000 feet of his cement tile have already been used for the roofing of large plant buildings. This material makes excellent roofing, being fireproof, weatherproof, and having long wearing qualities.

The Photostat.—Tracing, and even copying, are all right in their places but since the invention of the photostat these places are not quite so inclusive as they were. For many purposes a photostatic copy of drawings, specifications, etc. is quite as satisfactory as any other and there is no comparison under the head of cost.

Belt Salvage.—Leather belts that have been retired from service need not be regarded as a total loss if an article in *Machinery* of January last is taken as text. A method of restoring the belts to service after reinforcing them with woven cotton fabric is described in sufficient detail to make possible the application of the instructions given

White Paint and Machines.—Much is written and said these days about the necessity of proper lighting in the factory and lighting engineers have done some very useful things to our shop walls and windows. A new stunt of considerable interest in this direction consists in the liberal application of a coating of white paint to the lathes, planers and other machines about the shop

The Interchangeable Pyrometer—To those who have been in the habit of looking upon the thermocouple as essentially a cut and try affair whose calibration must be done separately for each couple and with much pains, it will come as a shock to learn that there is now on the market a pyrometer whose thermocouple can be replaced by the user when replacement is necessary Such a pyrometer is obviously much cheaper in use than one in which the couples must be bought completely assembled.

Wear on Tolerance Gages.—James Parker in a recent issue of *American Machinist* makes a point which is obviously a good one but which we do not recall having seen brought out explicitly until now In practically every case where a pair of go and not-go gages is used the design of gage and piece gaged is such that one gage makes contact with all the passed pieces, and gets continuous wear while the other gage makes contact only with the oversize or undersize minority and accordingly gets little wear In most shops it is probably the practice to discard the gage when it shows wear beyond a definite limit It is suggested that in many cases a revision of the tolerances demanded in the direction that leads to this wear would leave the product in just as good shape as before and save much gage expense. A "go plug gage for instance made to exact size wears out almost immediately and one on which the gage-maker makes even a slight minus tolerance is partly worn out before it is ever used.

Machining Aluminum.—Aluminum enters so largely into machine construction today that it is necessary to study closely its characteristics from the machining standpoint. Some excellent practical advice on the subject is given in a handbook published by the British Aluminum Company The company has investigated thoroughly the numerous aluminum alloys with a view to determining their machining qualities and the most suitable treatment. For turning drilling or milling a high speed is found best, and the tools should have acute cutting edges, preferably finished on an oil stone For the clearance angle of a lathe tooth 15 degrees to 20 is advised and with the smaller angle a 5-degree top rake may be given Cutting speeds of about 600 feet per minute are permissible and a heavier and faster feed than with brass may be employed For screwing purposes a special alloy is supplied and paraffin is recommended as a lubricant instead of turpentine, which tends to leave a [illegible] deposit that may cause the screw to bind. In milling the best results are said to be obtained by the use of a built-up tool, the cutting being ground with sharp corners. The cutters should only cut at the extreme points and not have a scraping action as with brass. Cutting speeds of 500 to 800 feet per minute are commonly used. When grinding aluminum the wheel should first have a piece of paraffin wax held against it to fill up the pores. A wheel so treated will not cause the metal to adhere to it and will not require to be so frequently [illegible]

Patents and Trade-Marks Notes

Trade-Mark "C. & C."—A recent trade-mark decision is of marked interest to the public at large In this case, Cantrell and Cochran Company, Ltd, firmly established its rights to the trade-mark "C. & C." for ginger ale, particularly in combination with the word 'Belfast." The decree in the case in question recently issued by the Supreme Court of the District of Columbia, enjoins a firm of local bottlers from using the trade-marks complained of and directs the surrender of, and forbids the use of, any labels bearing such infringing marks, which would tend to deceive the public as to the brand of ginger ale sold

Commercial Success as Evidence of Invention.—The importance in resolving any doubts as to the question of invention, of commercial success and practicability, is very frequently dwelt upon by the courts in decisions in patent cases Such commercial success in itself does not constitute evidence of invention, but it has great effect in resolving any doubt in regard thereto in favor of the inventor In a recent decision the United States Circuit Court of Appeals of the Third Circuit (Sandusky Foundry & Machine Co vs Laband, et al 274 F 607), held that even somewhat vague and general proof of commercial success is sufficient to constitute evidence of invention in the absence of contradiction

Recovery for Infringement of Patent.—In equity the rule for recovering for infringement of a patent is that where the net profits earned by reason of the infringement do not sufficiently compensate the owner of the patent for its infringement, there may in a proper case, be awarded damages in addition to the ascertained net profits, and punitive damages may be awarded in the court's discretion but ordinarily the pecuniary gains arising from sales of an infringing article disclose the usefulness and commercial value of the thing invented as well as its disadvantages and may well constitute a guide to the true measure of damages (Phila Rubber Works Co vs U S Rubber Reclaiming Works 276 F 600)

Effect of Later Patent, in a Suit Upon a Prior Patent.—It is a well-established principle of law that the issuance of a later patent is prima facie a presumption of a patentable difference between it and an earlier patent as laid down in a number of decisions of the Supreme Court of the United States for example in Miller vs Eagle Mfg Co (151 U S 186) Relying on this decision and others the United States Circuit Court of Appeals for the Ninth Circuit, in Western Well Works Inc. vs Layne & Bowler Corporation (276 F 465), again expressed the rule that the issuance of a later patent raises a presumption that the invention claimed is different from that of an earlier patent and the burden of proof rests upon the complainant to establish infringement It must nevertheless be remembered that despite this presumption it is quite possible for a patent to be infringed by a machine or an article which itself may be covered by one or more perfectly valid, later patents and the question involved is not one of actual infringement but merely of the burden of proof of such infringement.

Proper Names as Trade-Marks.—Anyone has the right honestly to use his own name in connection with his business, even though this use should interfere or injure the business of another provided, however, that he uses every reasonable means he can to distinguish his own business and the merchandise which he places on the market from those of his competitor In Stix, Baer & Fuller Dry Goods Co vs American Piano Co 211 F 271, the Court of Appeals in the Eighth Circuit said "It is now settled beyond controversy that a family surname is incapable of exclusive appropriation in trade The right of every man to use his own name in his business was declared in the law before the modern doctrine of unfair trade competition had arisen It is part of the law of trade-mark The subject may, therefore, be properly approached from that side If, however, the name has previously become well known in trade the second comer uses it subject to three important restrictions (1) He may not affirmatively do anything to cause the public to believe that his article is made by the first manufacturer. (2) He must exercise reasonable care to prevent the public from so believing (3) He must exercise reasonable care to prevent the public from believing that he is the successor in business of the first manufacturer."

Electrical Notes

Summaries and Excerpts from Current Periodicals

Tokio Superpower System.—An American manufacturer has received orders from an electric company of Japan for electrical equipment to be used in two large hydro-electric plants, which are to form part of a superpower system in the Tokio district. The current is to be transmitted at 154,000 volts. The total value of the equipment is about $2,000,000.

Electric Steam Boiler.—The efficiency of the electric steam boiler of fire tube type is practically 100 per cent, according to the *General Electric Review* This high efficiency is due to the fact that all the energy is expended inside the boiler, and if properly heat-insulated the losses from radiation are negligible. These boilers will appeal to engineers for the reason that standard boilers, transformers, governors and auxiliary devices are used

Final Report on the Electrification of Railways.—The report of the advisory committee of the British Ministry of Transport presents the conclusions arrived at after thoroughly studying the operation of various systems of railway electrification and the extent and character of engineering regulations desirable to facilitate continuous travel over connecting railway lines. The principal recommendations of the investigation are not limited to British practice, but are of international application These are (1) That three-phase alternating current be the standard system of power generation, (2) that direct current be the standard system of power distribution, (3) that 1500 volts, a multiple or sub-multiple be the standard distribution potential, (4) third rail, the overhead wire, or both, to be the standard distribution conductor

Telephoning Through Cables.—In a recent issue of the *Journal* of the Institute of Electrical Engineers (British) there appears a discussion of the nature of telephone transmission problems and the importance of the attenuation constant. The effect of varying the line constants is discussed and summarized in a table, and the improvement obtained by the addition of inductance in the form of loading is illustrated. Tables are given of the coil-loaded and continuously loaded cables that have been laid. The introduction of telephone repeaters necessitates a smooth impedance frequency curve for the cable, and this is more readily obtained with continuous loading. A comparison is made of the two methods now used in loading telephone submarine cable, showing that the balance of advantage is on the side of the continuously loaded cable.

Electrically-Equipped Furniture.—The latest novelty is electrified furniture, so to speak. It was first talked about in 1915, according to *Electrical World*, but it is only during the recent past that progress has been made in this direction Electrified furniture is nothing more than furniture that has been wired and provided with suitable electrical outlets to facilitate the use of lamps or electrical devices. Thus the electrified bed is one in which outlets are provided along the edges of the bed so that a heating pad, reading lamp, milk warmer or other devices may be readily connected. An electrified tea wagon is provided with a pair of outlets at the rear, so that the electric coffee percolator, electric grill or electric toaster may be readily connected. The National Electric Lamp Association thinks well enough of the electrically equipped furniture to have drawn up a set of specifications.

Electric Locomotive Drives. — Brief comments on two lines of development, namely, the quill and the coupling-rod types, are contained in a recent issue of *Engineering.* Reference is made to experience of some American engineers, particular attention being called to some comparative tests of steam and electric locomotives. In conclusion, the writer says: "It is quite possible that in freight working, or, indeed, in such passenger service as is probable in this country for some time, the quill or direct-current drive may suffice; but there would seem, on the other hand, to be little doubt that the freedom in electrical design presented by the introduction of the coupling-rod drive, taken with the indisputable advantage of the higher center of gravity, will insure this machine a very good share of popularity, especially where easy running and good speed are sought for on curved roads.

Electricity in the Far North.—An article in the London *Engineer* of recent date contains a comprehensive account of one of the northernmost electrical developments in the world—that at the Porjus waterfall in the extreme north of Sweden within the Arctic circle. This hydroelectric plant serves the industrial interests engaged in mining the immense deposits of iron ore made accessible by railroad construction in comparatively recent years. 5,000,000 tons of iron ore being now exported annually from the district. In deference to the tourists one waterfall above the Porjus development has been permanently reserved as a scenic feature. The Porjus water power is a combination of rapids and falls, one and a quarter miles long, which continue to the Gulf of Bothnia as the Great Lule River Here three 10,000-kw generators deliver energy at 80,000 volts over a 200-mile transmission line.

A Voltmeter That Measures in Hundreds of Thousands.—With the gradual increasing of transmitting voltages up to nearly one-quarter million volts, it is interesting to note a new voltmeter developed in England for the measuring of high potentials. The new voltmeter is based on the principle employed by Lord Kelvin, and subsequently developed by M Abraham, the eminent French investigator, of the attraction of two oppositely electrified conductors protected by guard plates. The instrument can be built for measuring pressures up to 200,000 volts. The change-over from one range to another is immediately effected by altering the distance between the plates. An important feature of these voltmeters is that air being used exclusively as the dielectric, they give identical readings with direct current or alternating current of any frequency, which is not the case with electrostatic voltmeters depending upon the use of condensers.

A Novel Method of Road Illumination was employed for night racing at the Oregon State Fair last fall, according to a description in *Electrical World.* The lighting equipment consisted of 68 1000-watt, 120-volt lamps supported in enameled-steel elliptical angle reflectors equipped with special hoods made to receive "mogul" series sockets. The fixtures were hung at an angle of about 20 degrees from vertical This was done so that the lighting units might be hung at least 10 feet from the edge of the track to keep the light as much as possible out of the racers' range of vision and at the same time give the proper distribution of illumination The elliptical type of reflector was chosen because a wide distribution was wanted parallel with the track. The poles were spaced 240 feet apart on the curves and 320 feet apart on the straightaways. The use of the series system of circuits reduced the cost of the wiring materially and made it possible to use the messenger cable for the conductor by placing an insulator in the cable at each fixture

Electrically-Driven Plows.—Two different types of electrically-driven plows have been recently built and tested by two French concerns, according to *Revue Generale de l'Electricite.* A small plowing set, built by Douilhet, consists of two little trailers each with a 15-horsepower motor-driven cable drum holding 500 meters of 6-millimeter steel cable. The two trailers are placed alongside of the field. Two stationary pulleys, anchored in the ground, lead the cable ends to the plow, which goes to and fro across the field. After each furrow the pulleys have to be reset, and after each 30 meters of furrows their anchorage has to be changed. A light self turning plow is used A large plowing set has two heavy trailers, each with two cable drums and one 60-horsepower motor Two permanent anchor posts are provided, and both trailers move the width of one furrow after each cross-plowing. The small set will plow one, the large set three hectares per day, at an approximate cost of 96 francs and 80 francs per hectare, respectively.

Radio Notes

A Review and Commentary on the Progress in This Branch of Rapid Communication

Health Hints by Radio.—A semi weekly radio telephone health bulletin service has been inaugurated by the United States Public Health Service It is planned to broadcast every Tuesday and Friday through the naval radio station at Anacostia Va a message of advice on how the average man and woman may insure continued good health Under very favorable weather conditions it is expected that the messages will be heard on the Pacific Coast, in Europe, and the north parts of South America.

Radio Telephone Broadcasting in France.—The popularity of radio broadcasting has extended far beyond our own borders England is doing a little radio telephone broadcasting so is Berlin and the idea is taking real shape in France We learn from a recent news despatch that 20 ballet girls danced to music played 25 miles away as a feature of a matinee The performance was witnessed by Prof Branley the pioneer wireless worker and ex President Poincare

Guiding Radio Waves.—A Ukrainian engineer is reported to have discovered a method by which radio messages may be sent to a definite receiving station without the danger of being intercepted by other stations. It is stated that by means of a simple apparatus the so-called locked power line of the magnetic field may be straightened out and grouped into parallel rays These rays are said to do away with the necessity of aerials If this report is true it seems that we are on the verge of a new epoch in radio However we shall have to wait for complete details before passing judgment on the merits of this new invention

Medical Service via Radio.—Arrangements have now been made whereby any ship provided with a radio outfit can receive prompt medical service from the United States Health Service through one of several Radio Corporation of America stations and other stations When it is remembered that only a small proportion of the total number of ships equipped with radio have a ship doctor the value of medical service via radio becomes apparent The ship in need of medical service can now call up the nearest radio station state the nature of the case or cases requiring medical attention and receive a diagnosis of each case and complete instructions as to treatment within a few minutes.

High Power Vacuum Tubes.—In connection with Great Britain's Imperial Chain—a world wide radio system that has been under way for a long time—the Technical Committee recommended the use of high powered tube installations A considerable amount of very valuable work has been carried out in the past year by the British Admiralty working in conjunction with the Mullard tube builders Much progress has been made in the construction of silica tubes, which have now been made in 10-kilowatt sizes. The result of this work will undoubtedly be seen in the forthcoming year We may expect a large number of land stations operating on valves of large power

Radio Equipment of the Ships "Paris" and "Lafayette" is described in a recent issue of *Radioelectricite* On both steamers a 5 kilowatt tube transmitter has been installed with a wave range of between 2000 and 9000 meters. A 5 kilowatt motor generator set is used to produce the plate high tension for four rectifying and four oscillatory tubes and the low voltage current for the heating of the filament of these tubes. Both vessels are equipped with a radio range-finder or radio goniometer" which reduced to plain English means a radio compass. A distance of 8400 kilometers has been covered safely by messages sent from the transmitter of the Paris

Armstrong's Victory.—By a recent decision of the United States Court of Appeals, the claims of Edwin H Armstrong as inventor of the regenerative action or the feed back arrangement in radio reception and transmission, are again upheld, as against the claims of Dr. Lee de Forest. No trans-Atlantic telephone conversation can be carried on without use of the Armstrong principle none of the big radio-phone broadcasting stations now sending music nightly through the air can operate except under the Armstrong patent even the modern multiplex form of wire telegraphy and telephony must pay tribute to Armstrong so it is claimed Indeed the Armstrong regenerative action or feedback constitutes one of the greatest advances ever made in the radio art.

The Radio Industry.—It is evident that the radio industry has expanded to undreamed of proportions within the past few months It is not surprising therefore, to learn that one concern expects to do a business of well over $50 000,000 this year judging by the returns of the past few months. There is an ever-increasing demand for vacuum tubes it is estimated that by this writing 75,000 tubes are being turned out a month and that by the time this reaches the reader the production will probably exceed 100 000 tubes per month. Authorities in and out of radio are of the opinion that the radio business as it is now developing is going to be greater than the phonographic industry which has been doing a business in excess of $400 000 000 per year

Radio Link in Telegraphy.—Experiments on substitution of a radio transmission link for the customary wire transmission lines on the commercial multiplex printing telegraph have recently been carried on Results are given of tests made between New York and Cliffwood N J a distance of 25 miles The usual outgoing signals from the printer were transmitted by wire to the radio room, where by means of a relay controlling the radio transmitter they were converted into radio signals The received signals at Cliffwood actuated a polar relay and converted the radio signals back to wire signals which were relayed by wire back to the printer laboratory in New York These tests showed that 180 words per minute could be satisfactorily sent according to the *Journal of the Franklin Institute.*

World Wide Radio.—Every leading nation is interested in establishing a system of world-wide radio Germany had such a plan before the war which had a distinctly military tendency rather than a purely commercial attempt to keep in touch with all countries both far and near Great Britain has had a world-wide radio plan for many years, and of late the subject has been very much in the forefront of British circles. It is understood that the present plan considers six principal centers between which reliable radio communication is required namely—Great Britain Canada, Australia, New Zealand South Africa, and India. Geographical considerations suggested the postponement of Canada and New Zealand Of the remaining four Australia, South Africa, and India form an equilateral triangle about 5000 miles along each side while England is about 6000 miles from South Africa 5000 miles from India, and 10 000 miles from Australia The United States has also a plan for world-wide radio which is rapidly progressing towards realisation

Efficiency of Radio Plants.—In a recent issue of *The Electrician* there appears the following editorial comment, which offers sound food for thought Apart from the press stunts, of which wireless has been the victim (or conspirator) the thing that most strikes the observer of progress in this branch of electrical service is the enormous disproportion between the hundreds of kilowatts utilised at the transmitting end and the few microwatts picked up at the receiver No doubt this apparently inevitable state of affairs has had its influence upon those who have been engaged in the practical development of wireless, for it is only within recent years that any progress has been made in the rounding up and extermination of the losses which take place within the transmitting plant itself. The old spark transmitter had an efficiency in the neighborhood of 15 per cent, but it is only necessary to inspect the oil-cooling system of the high-frequency alternator the water jacketing of the arc, or the red-hot anodes of the very latest transmitters, the [illegible], to realise that even present-day engineering [illegible] [illegible]

Aeronautical Notes

A Flying Friar.—A Capuchin friar has requested the Spanish Government to let him take part in the Moroccan campaign with a machine of his own invention

"ZR-2" Inquiry.—It is found that the design of the ZR-2 was never examined and discussed by any official committee before construction was begun The Court of Inquiry finds the accident due to structural weakness

A Prize of One Million Francs has been offered by the Administrative Council of the Committee for Aeronautical Propaganda in France, for an airplane engine which will give satisfaction in severe tests of durability reliability swift dismantling erecting etc Tests will begin in June 1923 Competition is open to the world

Taking Baby for an Airing.—The weathercock atop the 200-foot steeple of the parish church in Leister England was surrounded by rain cold and fog when three visitors arrived They were Herbert Neville 64 his son 33 and his grandson a fine 20-pound baby Son carried grandson while mother and grandmother anxiously watched the climb from the church tower

Altitude and the Human Organism.—Mountain miners in the Andes do heavy labor in a rarified atmosphere that makes the slightest effort fatiguing to newcomers American and Canadian scientists are in Peru to discover whether this immunity of the miners is due to changes in the blood or to other functions. The scientists will yield their own blood both at sea level and at three miles altitude and the samples will go to our universities for analysis

Flights in Fog Made Safe.—A French navy lieutenant has perfected a system whereby the principle of the submarine cable for directing ships is now applicable to airplanes flying by night or in a fog Two or three amperes of alternating current are sent over telegraph wires electromagnetic appliances aboard the plane are tuned to the same frequency The pilot is said to pick up vibrations easily from a distance of three miles, and to follow the wires without difficulty

Fire Fighting by Airplane.—Paris stirred by the 40 000 000 franc fire that consumed a big department store is considering the equipment of air planes with fire extinguishing bombs These would be filled with a gas that chokes out the flames without being injurious to the neighboring population Aviators proposing the plan claim one airplane could carry enough bombs to extinguish a large fire well under way Experiments are to be conducted in the suburbs to determine the feasibility of the scheme

Dirigible vs Airplane.—The ZR 2 disaster was closely followed by the destruction of the Navy balloons at Rockaway From the time England's first big airship built by Dr Barton crashed in its maiden flight at Muswell Hill the history of large dirigibles has been full of failures The airplane has progressed in size safety and speed from year to year Its supreme importance as an arm of defense is unchallenged and it might be better to let other nations dally with the expensive and dangerous gas bag and to strive wholeheartedly for supremacy in heavier-than air machines

Gliding in Germany.—The gliding experiments of Herr Hans Richter have been attracting no little attention even from this side of the water This German experimenter began his first experiments in 1908 and is said to be the earliest of all glider fliers now living in Germany He is, in fact the first German glider since the late lamented Herr Lilienthal, according to *Aeronautical Engineering* In a recent glider tried by Richter the aviator rests his elbows on the longitudinal members of the frame and controls the fore and aft attitude of the machine with an ordinary tail elevator operated by a short lever which is worked by a movement of the wrist. The machine is designed to be inherently stable laterally, and consequently no lateral controls are fitted The aviator's own legs form the undercarriage of the machine. Altogether Herr Richter has made more than a thousand flights with his various types of gliders, and with those of other constructors. It is noteworthy that the very keenest interest is taken in gliding in Germany where gliding competitions with quite a large number of entrants have taken place in the hills of the Rhon.

CLASSIFIED ADVERTISEMENTS

The Market Place for the Small Advertiser

Advertising in this section is $1.00 a line. No less than five nor more than twelve lines accepted. Count seven words to the line. All orders must be accompanied by a remittance. Advertisements for insertion in July number should be received by May 20th.

AGENTS WANTED

AGENTS, 600 profit. Free sample. Lowest priced Gold and Silver Sign Letters for stores, offices, automobiles. Large demand. No experience necessary. $50 to $200 a week easy. Exclusive territory. Acme Letter Co. 2800 A Congress St. Chicago.

AGENTS. Here's big money and independence. $2.50 invested nets $28.25 profit. $5.00 nets $63.60. Apply initials to side doors of autos. Every car owner a prospect. Newark Monogram Company, Desk 30, 565 Broad Street, Newark, N. J.

AMBITIOUS WRITERS

AMBITIOUS WRITERS send today for free copy America's leading magazine for writers of Photoplays, Stories, Poems, Songs. Instructive, helpful. Writers Digest, 692 Butler Bldg., Cincinnati.

AMERICAN MADE METAL TOYS AND NOVELTIES

MANUFACTURERS WANTED on large or small scale for production of metal toys and novelties. Toy soldiers, cannons, machine guns, cowboys, Indians, wild animals, whistles, bird whistles, race horses, baseball players, paper weights, match holders, automobile ornaments, souvenirs, advertising specialties, and hundreds of other things. No experience or tools necessary. Hundreds and thousands made complete per hour. Bronze casting forms furnished to manufacturers complete with outfit from $5.00 up. We buy these goods all year, paying fixed prices. Contract orders placed with manufacturers. An enormous business is offered to industrious men this year with an excellent opportunity to enter this open field. Write us only if you mean strictly business. Catalog and information free. Metal Cast Products Company, 1696 Boston Road, New York.

AUTOMOBILE OWNERS

FORD Car Repair Book sent free. This complete, well illustrated valuable book explains in a simple way the Causes and Cures of Over-heating, Repairing Ford Timer, Curing Piston Ring Troubles, Carburetor Adjustments and Repairs, Connecting Rods, Transmission Troubles, Care and Repair of Rear Axle, Stopping Axle Grease Leaks, also covers practically every other phase of Ford Car Repairing. Send 25c coin for three months trial subscription and get the valuable repair book free. Ford Owner and Dealer Magazine, 301 Montgomery Bldg., Milwaukee, Wis.

AUTOMOBILE OWNERS, Garagemen—Mechanics—Repairmen, send for free copy of this month's issue. It contains helpful, instructive information on overhauling, ignition troubles, wiring, carburetors, storage batteries, etc. Over 120 pages, illustrated. Send for free copy today. Automobile Digest, 542 Butler Bldg., Cincinnati.

50c for a foolproof automobile spring oiler! Car owners enjoy smooth riding! Compton Spring Oilers stop squeaking, clean, keep out rust, automatically lubricate springs. Send $4.00 complete set 8 oilers. Special Ford set 4 oilers $2.00. Profitable discount to wholesale dealers able to finance own stock orders. Compton Spring Oiler (16) Co., 30 Broadway, New York.

BUSINESS OPPORTUNITY

PARTNER wanted to finance the manufacture and marketing of Coin Sorting Machine. Fully protected by U. S. Patents. Will separate 2000 coins (of all denominations) a minute. Floor space 12" x 14", light and portable. All parts die made and interchangeable. Will sell for ten times its cost. For further particulars address W. I. Paul, Beaufort, N. C.

PROFITABLE sales by mail! Circularize newly compiled mailing lists 15,000,000 classified names. Example: 200,000 wealthy rural mail order buyers, 3,000,000 farmers (by states) $6.00 thousand. Responsible firm's offer. You'll want more. Lo Martinek Co., Corona, New York.

YOU CAN have a business profession of your own and earn big income in service fees. A new system of foot correction, readily learned by anyone at home in a few weeks. Easy terms for training, openings everywhere with all the trade you can attend to. No capital required or goods to buy, no agency or soliciting. Address Stephenson Laboratories, 23 Back Bay, Boston, Mass.

ELECTRIC railways, public utilities, water, timber, oil, industrial and mining enterprises promoted. Approved bond and stock issues placed with European bankers and brokers. Underwriting procured for corporations. Mining and other examinations and reports made by well-known engineers. Irish Minerals and Industrial Development Company, 12 Upper Camden Street, Dublin, Ireland.

I TRAVEL over entire United States appointing territorial, County and State distributors, and can represent another manufacturer who has a new Patented Specialty ready for the market. I must have control of the Sales end of the entire United States. Address Expert Organizer, General Delivery, Flushing, New York.

BE MORE SUCCESSFUL buying, selling, trading. Master dealer system makes real estate easy, safe, profitable. Guaranteed or costs nothing. Interesting booklet explains all. Send today. Instruction Dept. Stephens Realtor Service, Muncie, Indiana.

MANUFACTURER or Capitalist wanted to make and sell on royalty basis a new and novel feature double heat electric heater, reflector type. United States and Canadian Patents. Millions sold yearly. "Excelsior," Box 186, Scientific American, New York.

GRANDFATHER clock works $5.00. Build your own case, instructions free, make good profits selling your friends. Clock works with chimes for old or new cases. Write for full particulars. Clock Co., Buffner St., Philadelphia, Pennsylvania.

SCHEMER MAGAZINE, Alliance, Ohio. 40-page monthly prints big profit schemes, one subscriber making $25,000 from three, another $10,000 from one. Try your luck. Year only $1.00; three months 25c. None free.

RESPONSIBLE corporation wants general sales managers to open branch office, manage salesmen. $500 to $5000 necessary, expenses to Baltimore allowed if you qualify. Address Manager, 603 N. Eutaw Street, Baltimore, Md.

BUSINESS OPPORTUNITY

PATENTS. If you have a patent to sell or lease, send particulars to Supply and Demand, 1838 Broadway, New York.

GALVANIZING tire rims, awnings, signs, boat fittings, spikes, bolts and contractors' material and hundreds of other things exposed to the weather. Galvanizing a paying business, requires very little capital to start. Address P. O. Box 538, Charleston, S. C.

EXPERIMENTAL RUBBER WORK

WE DO experimental compounding, vulcanizing tests, chemical analyses, develop your rubber ideas, processes, inventions. Let us advise you. Consult us. Kent Rubber Laboratory, Consulting Engineering Chemists, Box 186, Kent, Ohio.

Mr. Advertiser:

Do you realize the opportunity that this Classified Department offers to you in broadcasting your wants or offerings to an audience of over one hundred thousand readers? Spread over the period of one month, it would take an organization the size of a metropolitan department store to accommodate this many prospective purchasers. Yet SCIENTIFIC AMERICAN, through the medium of the Classified Department, will effectively carry your message to this great assembly at a cost of approximately two mills a word for each thousand readers, or fifteen cents a word to reach the entire audience. At this rate the small advertiser is enabled to merchandise his products over a period of one month at a cost commensurate with the market that SCIENTIFIC AMERICAN affords.

The value of this market is manifested in the ever-increasing number of advertisers using space. If you are interested in having your advertising message broadcasted to this audience, send in a trial advertisement.

Classified Manager
SCIENTIFIC AMERICAN
Woolworth Building
New York City

FOR INVENTORS

PRACTICAL instructions to inventors and patentees written by the manufacturer and inventor Charles Hunnicutt, covering every problem relating to inventions. Experience has shown the best means of patenting, manufacturing and marketing inventions. Written in the plain style of an honest man. No patent lawyer connections. For sale by Thos. Coonan, Exclusive Agent, 1231 North Capitol St., Washington, D. C. $1 prepaid. Satisfaction or money refunded.

INVENTOR and Manufacturer. Let us be your machine shop. We make models, build special machinery, tools, dies and manufacturing. We have a modern daylight factory with precision machinery. Send blue prints or sketches for estimate. Victor Engineering & Mfg. Co., 2824 W. Chicago Ave., Chicago, Ill.

PATENTS. If you have an invention which you wish to patent you can write fully and freely to Munn & Co. for advice in regard to the best way of obtaining protection. Please send sketches or a model of your invention and a description of the device explaining its operation. All communications are strictly confidential. Our vast practice, extending over a period of seventy years, enables us in many cases to advise in regard to patentability without expense to the client. Our Hand-Book on Patents is sent free on request. This explains our methods, terms, etc., in regard to Patents, Trade Marks, Foreign Patents, etc. Scientific American contains Patent Office Notes, Decisions of interest to inventors, and particulars of recently patented inventions. Munn & Co., Solicitors of Patents, 626 Woolworth Bldg., New York; Scientific American Bldg., Washington, D. C.; 801 Tower Bldg., Chicago, Ill.; Hanna Bldg., Cleveland; Hobart Bldg., 582 Market St., San Francisco, Calif.

FOR INVENTORS

INVENTIONS—If you have one we may develop and market it for you. Special facilities, confidential service, square deal. Castonguay Engineers, Thompsonville, Conn.

FOR SALE

PATENTS No. 1,396,654 U. S. and No. 202,566 Canadian for sale outright or on royalty basis. A valuable article in universal demand. Manufacturing cost small. It will pay you to investigate. H. G. McNeely, Tulare, Calif.

WILL SELL non refillable bottle patent at worth while price. For more details write to D. G. Abels, Chehalis, Washington.

How to Build Beautiful Homes At Small Cost. Read My Book on the Twentieth Century Building Materials. Price One Dollar. Peter de Linde, Zion, Ill.

SELL YOUR property quickly for cash, no matter where located. Don't pay big commissions. Particulars free. Real Estate Salesman Co., Desk A, Lincoln, Neb.

DRAWING INSTRUMENTS, slide rules. Highest quality, lowest prices. Direct from importer, circulars free. Automotive Engineering Co., Castle Hall, Indianapolis, Ind.

HEMSTITCHING and picoting attachment works on any sewing machine, easily adjusted. Price $2.50 with full instructions. Oriental Novelty Company, Box 11, Corpus Christi, Texas.

HELP WANTED

RESEARCH ENGINEER

An attractive position with exceptional opportunities for the future is open to a man having the right qualifications. The position requires ability to apply sound scientific principles and reasoning to the analysis and solution of a very wide variety of general technical problems demanding fundamental research. These problems are mainly in the general field of mechanical engineering, although many of them are typical problems of physics and chemistry, some of them requiring special mathematical ability.

Applicants for this position should have had not less than five years of active experience in research along the lines indicated above. They should have had advanced scientific as well as engineering training, with special regard to fundamentals rather than to details of engineering practice.

Such courses of instruction, for instance as lead to advanced degrees in physics, chemistry and mathematics, with special reference to mechanics and thermodynamics are of much importance. Equally important is a sound knowledge of practical engineering problems and appreciation of the various factors which must be considered in applying scientific analysis to these problems. The applicant should state particularly the lines of engineering with which he is familiar and the extent of his acquaintance with other engineers in these lines.

Ability to summarize scientific and technical papers and to write up technical material for publication is of importance, as is ability to maintain cordial relations with other engineers engaged in similar lines of work.

State when available and salary. Box 182, Scientific American.

BE A DETECTIVE. Earn big money. Great demand everywhere. Excellent opportunities for travel. Fascinating work. Experience unnecessary. Particulars free. Write, American Detective System, 1968 Broadway, New York.

MAIL ORDER METHODS

$30 A WEEK evenings home—I made it. Sample article and plan 25c. Booklet for stamp tells how also you can earn $19 a hundred stamping names on key checks. Sample and instructions 25c. Alexis Scott, Cohoes, N. Y.

PERSONAL

EXCHANGE cheery letters with new friends! Lots of fun! Send stamped envelope for information of our exchange plan. Betty Lee, 426 East Bay Street, Suite 19, Jacksonville, Florida.

RADIO

BUILD RADIO SETS. We supply parts or complete units. Catalog 15 cents. Easily understood assembly drawings. Crystal Detector Set, Non-regenerative Receiver, Regenerative Receiver, 2 Step Amplifier, 25 cents each. All five $1.00. No stamps accepted. Hatfield Airfone Company, Owego, N. Y.

RADIO FOR EVERYBODY—352 pages profusely illustrated with an accurate description of all types of receiving sets and wiring diagrams adaptable to your particular location, with instructions of how to make them. Written by an authority on radio in plain understandable English. Gives the rudiments of radio for beginners and hook-ups for the advanced. Bound in cloth, $1.50 postpaid. Dept. C, Box 778, City Hall Station, New York City.

SCIENTIFIC INFORMATION

SUCCESS or Failure? Which is your destiny? Scientific information, "Success" pointers and Personality sketch for 10c and birthdate. Thomson-Heywood, Dept. 85, Chronicle Bldg., San Francisco, Cal.

STAMPS

FREE! Sectional Loose Leaf Postage Stamp Album at the rate of 8 pages each month given with subscription to our monthly journal. Send two-cent stamp for prospectus. United Stamp Co., 140 S. Dearborn St., Chicago, Ill. Dept. E.

STAMPS—50 varieties, Africa, Brazil, Peru, Cuba, Mexico, etc. 10c; 50 different U. S. 25c; 1,000 hinges, 10c; 1,000 mixed 40c. List free. C. Stegman, 5952 Cote Brilliante, St. Louis, Mo.

WANTED

AMBITIOUS MEN $40.00, $150.00 weekly. Become advertising writers. Students frequently earn $20.00, $40.00 weekly while learning. Prepare quickly at home, spare time. We assist you to position. Write Applied Arts Institute, Dept. 207, Witherspoon Bldg., Philadelphia.

Book Reviews

CONNECTING INDUCTION MOTORS. By A. M. Dudley, B.S. in E.E. New York: McGraw-Hill Book Company, 1921. 8vo. 252 pp. illustrated.

The material of this volume was originally a series of articles answering in a general way many actual questions relating to inductor motor connections and the possibilities of making changes to meet varying conditions of voltage, phase, etc. While written mainly from the repairman's viewpoint, it has much that will tend to solve the problems of operating engineers and make smooth the way of armature winders. The work is rich in good diagrams.

SOARING FLIGHT: A Simple Mechanical Solution of the Problem. By Lt.-Col. R. De Villamil (late R.E.). New York: Spon and Chamberlain, 1920. Paper; 12mo. 48 pp. illustrated.

An entertainingly written pamphlet reviewing research in the soaring or sailing flight of birds, clarifying the factors to be considered and advancing a theory that accounts for the bird "trapping energy" from the air without the expenditure of propulsive effort.

TECHNICAL DICTIONARY IN FOUR LANGUAGES. Edited by Edoardo Webber. New York: Isaac Pitman and Sons. 16mo. 921 pp.

Ordinary two-language dictionaries fail lamentably as aids to the understanding of foreign technical terms. The student reader will find this Technical Dictionary just the compact supplementary aid he so often requires. To the right of the English word appears its Italian, German and French equivalents, all in parallel columns with no necessity for turning the page.

THE WAY TO GREATER PRODUCTION. By Homer S. Trecartin and others. New York and Chicago: A. W. Shaw Company, 1920. 8vo. 252 pp. illustrated.

An urgent question of the industrial world is here put, and wisely answered by a number of men in the best of positions to tell what has been done toward its solution. The worker must be assisted to the needed knowledge and training and thus made the conscious master of his powers, and proper incentive must be provided in order to bring out his increased capabilities. Actual instances of successful campaigns of this sort are cited. The work concludes with a glance at the problems of factory management.

ELEMENTS OF MECHANISM. By Peter Schwamb, S.B., Allyne L. Merrill, S.B., and Walter H. James, S.B. New York: John Wiley and Sons, Inc., 1921. 8vo. 372 pp. illustrated.

Instructors who found this text to have many elements of appeal for technological students have suggested numerous changes that are embodied in this third edition. The work's chief claim to attention lies in the admirable selection and disposition of the material, which has resulted in a practical guide to the groundwork of the subject.

20TH CENTURY GUIDE FOR MARINE ENGINEERS. By J. A. Ramsey, Warrant Machinist, and J. Rosbloom, C.M.M., Instructor. Philadelphia: David McKay Company, 1920. 8vo. 587 pp., illustrated.

Reciprocating engines, boilers, turbines, gas engines and Diesel engines are painstakingly explained by two naval experts. The mathematics takes nothing for granted save ability to add and subtract, the problems are eminently practical. Among other things, condensers, ice machines, lubricants and electricity are adequately covered. A hundred questions and answers are a valuable feature of the arrangement.

REVOLUTIONARY THEORIES IN WIRELESS. By Frank E. Summers. Memphis, Mo.: Frank E. Summers, 1920. 8vo., 194 pp. illustrated.

Mr. Summers' book is in part an illustrated description of apparatus and experiments that familiarize students with wireless practice and related subjects, and in part an expression of his dissatisfaction with accepted theories, together with theories of his own that he hopes may simplify certain branches of science.

FIELD METHODS IN PETROLEUM GEOLOGY. By G. H. Cox, Ph.D., E.M., C. L. Dake, M.A., and G. A. Muilenburg, M.A. New York: McGraw-Hill Book Company, 1921. 8vo. 305 pp., illustrated.

This new work covers the [illegible] of one of our most important industries. Competent geologists have found a [illegible] field in this [illegible] of [illegible]

and have accomplished great things in the analysis of the structural conditions peculiar to oil territory New methods have been developed and old methods adapted to new needs Means and methods are fully discussed in this excellent handbook which takes up the minutiæ of field procedure presents geologic criteria, and carries the student through details of procedure to the final report.

Working Conditions Wages and Profits By C W Price and others. New York and Chicago A. W Shaw Company 1920 8vo 254 pp illustrated

Qualified writers and large manufacturers have joined hands in this attempt to answer the vital questions indicated by the title The results of the various wage systems are analyzed and compared there is an experience meeting as to the value of profit sharing most factors of loss and gain as they touch the worker are taken up illuminatingly and the result is a book of authoritative findings and tested plans that meets the present demand for answers to these urgent questions.

The Essentials of Advertising By Frank Leroy Blanchard New York McGraw Hill Book Company 1921 8vo 322 pp illustrated

The author has selected with rare judgment such phases of advertising as best demonstrate the groundwork of modern practice He starts the beginner aright and gives him a sound knowledge of the comparative advantages of the mediums employed of the duties of the more important positions and of many other primary considerations The easy step arrangement of lessons and the many illustrations spell gratifying progress for the serious worker

The End of the World By Joseph McCabe New York E P Dutton and Company 1920 8vo 267 pp illustrated

"The End of the World" is a brightly written unbiased account of the recent discoveries of astronomy and of the attitude of science toward the death of the universe It is popular writing of the best order conforming cautiously with the more solid contributions found in technical journals reconciling apparently conflicting views and stressing the permanent truths All is kept well within the intelligence of the inexpert reader and made undeniably interesting

Patternmaking By Joseph A Shelly New York The Industrial Press, 1920 8vo 341 pp illustrated

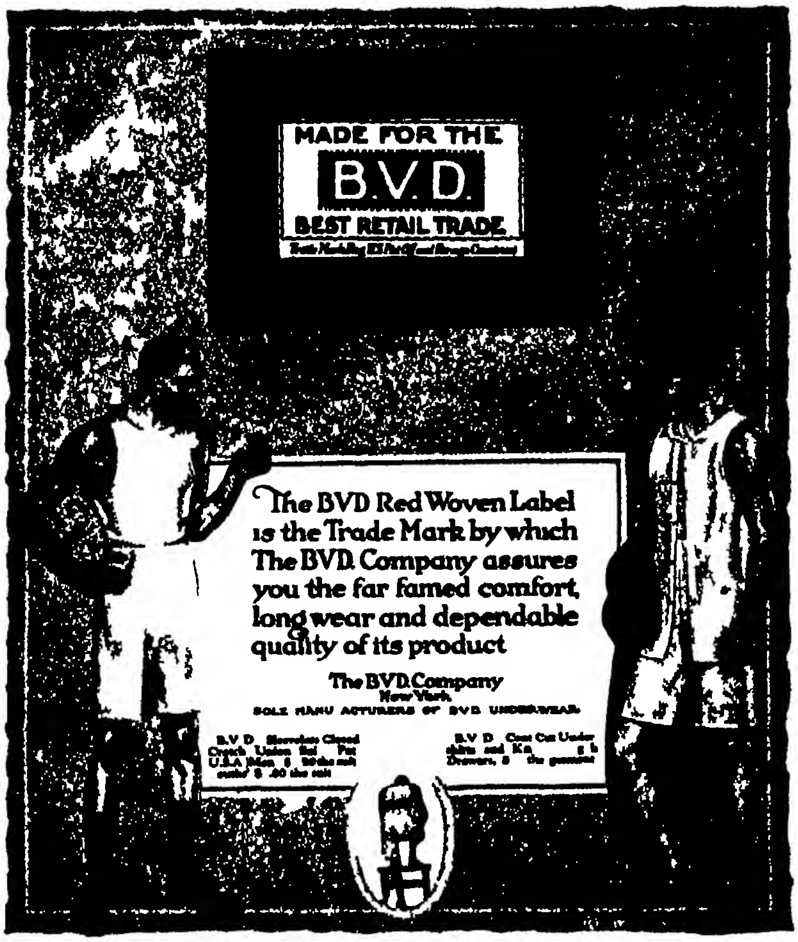
A competent patternmaker must know a great deal besides the construction of his forms He should be familiar with molding problems for there is close relationship between these and the types of patterns he must know joinery and the adaptability of hand and power tools to particular kinds of work These factors are expertly set down before the treatise turns to the general subject of pattern construction To the student of patternmaking and also to the draftsman the work will be exceptionally helpful

Physics of the Air. By W J Humphreys C E Ph D Philadelphia J B Lippincott Company 1920 8vo 665 pp illustrated

Reprinted from the *Journal of the Franklin Institute* these papers brings together from many sources descriptions and explanations of the numerous and complex phenomena of our atmosphere They clarify its mechanics and thermodynamics deal with electricity and auroras investigate atmospheric optics and summarize and discuss the factors of climatic control Methods of observation are set forth in text and illustration As a member of the staff of the Weather Bureau, the author has had opportunities and aids accorded but few and his work is correspondingly valuable to all students of atmospherics

The New Stone Age. By Harrison E Howe New York The Century Co 1921 8vo 280 pp diagrams and photographs

Cement and concrete have insinuated themselves—on their merits be it said—into nearly every branch of engineering so that there is a solid basis of truth for Mr Howe's title. His alluring work, while scientific in standpoint, is couched in popular language and the elements of suspense and surprise make it a gripping story Past history raw materials and their preparation the part played by chemistry and exactly what happens when the ingredients set and harden these are the themes of the book accompanied by thirty two fine illustrations that gratify the eye and inform the mind.



Stoking the Employee

(*Continued from page 3??*)

are more wholesome than inordinate quantities of ice water or, perhaps, a bit to cold.

As an illustration of present Steel Corporation practice four lunch rooms at three western plants seat from 130 to 260 and require from 26 to 38 employees to run them The average number of seats per restaurant employee varies from 4.54 to 6 84 the number of meals served per restaurant employee from 27 6 to 74 1 the number served per seat at noon the principal meal from 2 8 to 5 6.

Approximately half as many breakfasts as dinners are served and about as many suppers and midnight lunches each as breakfasts. The total daily average number of meals served at the four lunch rooms ranges from 1531 to 2106 In the year 1920 the total number of meals served at the four lunch rooms was 2 022 615. The average cost per meal to the employee in 1920 was 30 to 48 cents at present the cost at all four places is 30 cents a meal. The Corporation aims to serve meals at actual cost of food and service

The Westinghouse Electric and Manufacturing Company a near neighbor of some of the Steel Corporation s important plants, goes to the opposite extreme in its views regarding the proper size for an employees lunch room. Instead of a number of small lunch rooms scattered over an area giving employment to more than 25 000 persons in normal times the Company decided on one enormous restaurant. The reasons influencing this decision must have been as cogent as those which determined the other great

(*Continued on page 364*)

Transmitting Power in Fluid Waves

(*Continued from page 336*)

severest tests not only for wave transmission and hydaulic work, but for superheated steam acids etc Being impermeable inexpansible and leakproof the transmission efficiency is very high

It is a interesting fact that so long as waves are passing the water in a pipe line can ot freeze ndeed supposing a main to be frozen save for a thin core of water waves passed through the system will melt the ice In spite of this there is o heat loss at normal operating conditions heat generated in the high pressure zones is absorbed in the low and after the plant has been working for an indefinite time the pipes are cold

Ten horsepower waves have been transmitted through one inch piping to a distance of 240 feet. But there is no theoretical limit to the transmission distance The longer the line the greater the diameter required The practical limit comes when the initial cost and the drop in efficiency compare unfavorably with the corresponding items in competing systems. The conditions for best efficiency are large diameter of pipes, high pressure and high frequency Pipe diameter may be reduced as power is taken off at intermediate points It is not necessary to provide Y junctions for branch lines square tees are equally efficient.

In addition to its applications here outlined to reciprocating tools, the system has definite advantages as applied to rotary motion and to heating The possible range is therefore theoretically almost unlimited To the present its scope has been limited except experimentally to systems where economy convenience and safety are essentials Compressed air has hitherto been used for safety and convenience but its most fervid partisan can scarcely hold a brief for its economy Wave transmission is already in the field in mining and in mineral treatment its application seems at present to have touched only a fringe of the ultimate development. Experiments have shown that reduction gear for shipping use and for automobiles is practicable and variable-speed motors for all purposes are already in sight. In short, there seems to be practically no industry using transmitted power which may not ultimately be intetrested in wave transmission.

Sugars of Great Price

(*Continued from page 318*)

There are several queer things about the next most expensive sugar "mannose," at $125 a pound In the first place, it is a bitter sugar if the lay mind can grasp such a paradox. Although it has a sweetish aftertaste, its initial taste is decidedly bitter. Also, it is extracted from button waste, the scraps left after buttons have been made from vegetable ivory Furthermore, it is

Annual Subscription Rates

Scientific American (established 1845) one year $4.00

Postage prepaid in United States and possessions, Mexico, Cuba and Panama

Foreign Postage $1.00 per year additional

Canadian Postage $0.50 per year additional

Remit by postal or express money order bank draft or check.

also made from a sugar alcohol called "mannite" discovered as long ago as 1806 by Proust, in the manna of the Sicilian ash tree. Van Ekenstein first crystallized it in 1906 by a devious process and Harding developed a simple process for making it commercially from pants button residue in 1919

Next comes rhamnose at $100 a pound which, like several other rare sugars, obeys the Eighteenth Amendment, for it will not ferment. However certain bacteria can break it down into acetic, lactic and other acids, and that gives it its bacteriological job. First made by Rigaud in 1855 it is now manufactured commercially from black oak bark by a Harding process.

Next cheapest, at $90 a pound is wood sugar xylose its very name suggesting that it ought to be cheap It is plentiful enough in the form of a condensation product, because xylans are found in straw cottonseed hulls and corncobs as well as wood but until Hudson and Harding took it up in 1917 it was known only by the gram being so difficult to obtain Now it is made 10 pounds at a time. A strict prohibitionist xylose is not fermented by yeast but it is one of the most useful in bacteriological work unerringly picking out the criminal germs of typhoid cholera, enteritis and other intestinal diseases.

Aribinose at $81 a pound was first made in crystal form from gum arabic by Killani in 1880 and is one of the most useful tools of the bacteriologist, but used only to a limited extent on account of cost until made in quantity about 1915

Prices are coming down—presently we will find a few bargins. Melezitose levulose and inulin at $50 each per pound come next. The first is a trisaccharide or compound of three simpler sugars Discovered by Bonastre in 1833 it is made from a rare manna found in Turkestan and has only lately been available to scientists in working quantities, so it offers a wide field for study Levulose" is the sweetest sugar known about five times as sweet as cane sugar and occurs in honey as well as many fruits and vegetables, but is difficult to crystalize and for many years was known only in the form of syrup Now it is manufactured in crystals and promises to be better for diabetics than saccharine which is not a sugar at all but a complex derivative of benzene From a dietetic and bacteriological standpoint melezitose trehalose and melibiose offer virgin fields of investigation Inulin has been brought to highest purity by American chemistry for the first time

Galactose at $15 a pound maltose at $14 a pound mannite at $9 dextrose at $3 60 lactose at $2 and saccharose at $1 50 about wind up the rare sugars thus far manufactured on a commercial scale. Galactose was first made by the great Pasteur in 1856 by boiling milk sugar with acid and in our own destructive age has, like a good many other of the chemist's lesser known discoveries been perverted to the making of explosives Maltose is malt sugar widely distributed in nature, but difficult to obtain in the purity necessary for its useful work in identifying dysentery and diphtheria germs. Dextrose is common too being our old friend glucose which can be made from starch or even paper It is however expensive to purify for use as a diagnostic agent Lactose is another old friend—milk sugar transformed into a rare sugar when highly purified and saccharose is ordinary sugar bowl sugar rendered aristocratic by being profusely refined and in a state of absolute chemical purity

There are still possibilities for discovering new sugars Two were found in Washington by Dr F B La Forge—sedoheptose and d mannoketoheptose. Many of them have been made synthetically and the theoretical study of organic chemistry enables the investigator to predict what types of sugar he should find in nature and then find them A number of rare sugars already prepared synthetically have not yet been found in nature

The latest discovery in this little-known industry is a sugar called melibiose, made available commercially for the first time some weeks ago. Its raw material is raffinose, and it is so exceedingly rare in that product at $150 a pound that its market price has not yet been fixed But it will certainly exceed the price of trehalose and may be as high as $400 a pound Should that be the rate at which the bacteriologist and analytical chemist add it, for the first time, to the delicate working tools in their kits, the term "rare" applied to these substances will be comprehensible, for at that price "melibiose" is valued at about two and a half times its weight in gold!

Stoking the Employee

(Continued from page [illegible])

corporation in behalf of the small lunch room, for the huge Westinghouse restaurant was evolved from the free coffee proposition after long and careful study by the management.

The restaurant building, completed a little more than a year ago, on Braddock Avenue, East Pittsburgh outside the Company's grounds about midway of the plant and some ten minutes walk from the offices, is said to be the largest cafeteria in the world. So far as available information shows, it is the largest eating place of any kind for civilians. The building is a plain but neat-looking structure of brick and concrete, three stories and basement, 235 feet 9 inches long on the street front and 226 feet 8 inches at the rear by 90 feet 10 inches wide. There are neither elevators nor stairs in the building, all communication between floors being by ramps with maximum grades of 14 per cent.

The ground floor is divided into two rooms one of which is for women employees The second floor is thrown into a single room for men The third floor contains the kitchen dining-room for officers and foremen and an auditorium. Each room has a separate entrance and a separate exit, so that incoming and outgoing crowds are kept out of each other's way By this careful segregation and by the use of conveyor belts for diners' trays, already referred to and with a separate automatic conveyor belt from the kitchen to each of the eight service counters for replenishing the stocks of food the noon rush is handled with incredible celerity without trace of confusion The average time for a meal entrance to exit, is 22 minutes

The seating capacity of the building is 3200 Some comparative figures may be useful in arriving at an idea of the size of this eating place The largest single meal served in a hotel or restaurant concerning which data are available was the Sixty ninth Regiment dinner at the Hotel Commodore in New York two years ago at which there were 3167 guests A hotel serving 3000 meals from morning to night would be considered exceptionally large The largest popular-priced restaurant in New York serves about 2000 meals a day The Metropolitan Life Insurance Company serves 4500 or more lunches daily to employees at its New York headquarters but they are fed in three relays Thus to serve 3200 diners at a single sitting is seen to be no mean feat

For this undertaking a total of 185 restaurant employees is required In addition to these 30 waiters are employed in the officers dining room The kitchen is equipped with the customary power-driven meat and bread cutters vegetable peelers and mashers, cake mixers and so on of the latest type. Dishes are washed on two automatic machines with a capacity of 14 000 pieces each per hour

President Herr and his staff select their lunches from the identical menu provided for the employees which may be an indication either that President Herr is very modest in his tastes, or that Westinghouse employees are extremely well fed The only apparent distinction is that while the average check for girls is 17 cents and for men 37 cents President Herr and his staff are required to pay a minimum of 45 cents per meal to provide for the luxury of waiters

Taking the Riddles Out of Radio

(Continued from page 299)

leges cooperate in this work. During the Radio Conference receiving and sending sets were installed in the halls of Congress and at the radio headquarters so that the representatives at the conference could listen in on the debates in Congress A resolution was introduced in the House during the conference to broadcast the debates and daily doings of Congress throughout the country It is anticipated that such a service would reawaken public interest in Congress and its daily affairs and controversies and would admit of the accurate recording and dissemination of information about its actions. Many business firms find it essential to keep in close touch with Congress to know just what action is taken on different bills and measures. The actions of Congress and the times when they are taken frequently affect investments involving millions of dollars. The radio telephone is the most rapid medium for broadcasting such information. The time when a tariff bill goes into effect is of vital interest to a ship at sea bringing imports to this country The passage of a bill limiting or regulating immigration is of equal importance [illegible] the country to [illegible] speeches by means of radio telephone.

All the banking institutions doing an international business are awaiting the development of the radio telephone for their use. The radio telephone would have about the same relation to the cable that the long-distance telephone bears to the telegraph. The markets for foreign exchange and foreign bonds would be brought closer together by such a facility Messages could be sent over distances as great as [illegible] miles. The U S. Shipping Board announced recently that one of its vessels anchored at Buenos Aires talked with another sister ship in the harbor of Honolulu These two cities are 7000 miles apart, and this is reported to be a new record in wireless communication between ships at sea.

A novel use of the radio telephone which has been developed in Washington and was commented on favorably during the conference is the entertainment of soldier hospital patients by the use of the wireless method of communication At Walter Reed Hospital, one nurse can entertain several hundred convalescing soldiers simultaneously by reading stories into the wireless transmitter A phonograph can also be connected to the radio transmitter and music broadcasted through the hospital wards in this manner The soldier patients snap in place small clips which connect with their bed-springs and put an instrument like a telephone receiver to their ears and listen to the latest popular melodies.

The Necessity of Scientific Forestry

IN an interesting article in *Science* for October 28, 1921 Professor J W Toumey of the Yale School of Forestry in emphasizing the necessity of scientific forestry in this country says that industrial development proceeds faster in those countries in which domestic or imported wood is available in considerable quantities, and that industrial development becomes arrested when available wood supplies are reduced below the essential needs of industry

China at one time was well wooded. Prior to the exhaustion of her timber supplies she reached a stage in civilization and economic development beyond that of most other nations. She exhausted her forests centuries ago and has been without wood adequate for her essential needs for many generations. Historians have assigned many reasons for the early arrest in economic progress by the Chinese It appears, however that the progressive destruction of her forests far below the point of essential wood needs made the development of other industries impossible or extremely difficult.

Japan on the other hand, although surpassed in civilization and industry by China during the long period while Chinese wood was available in quantity has never exhausted her forests and now has wood in abundance There is every reason to believe that if Japan had followed China's example and had devastated and exhausted her forests and made no provision for regrowth, we would hear little of Japan today as a world power Greece, once powerful and prosperous, fell from her high estate many centuries ago

She swept the forests from her hills and mountains in attaining her power and in building her civilization She neglected regrowth and lost her place in the sun She is still without adequate wood for her essential needs. Switzerland a small nation of mountains and hills, though poor in soil and most other resources upon which the strength of a nation depends has retained her forests. She still has wood a basic resource. As a matter of course she is prosperous and forward moving

The republic of Switzerland only a little larger than the State of Connecticut, has three million people tilling less than 30 per cent of the land. Some of the forests were organized as early as 858 A.D. They have been continuously under timber production for more than 1000 years and are more intensively managed and more productive today than ever before.

In conclusion the author says that the forest history of the old world clearly proves that forests are overcut and otherwise destroyed when their control and management are left entirely to private land owners. No nation can perpetuate her forests through wise use unless they are publicly owned or publicly [illegible]

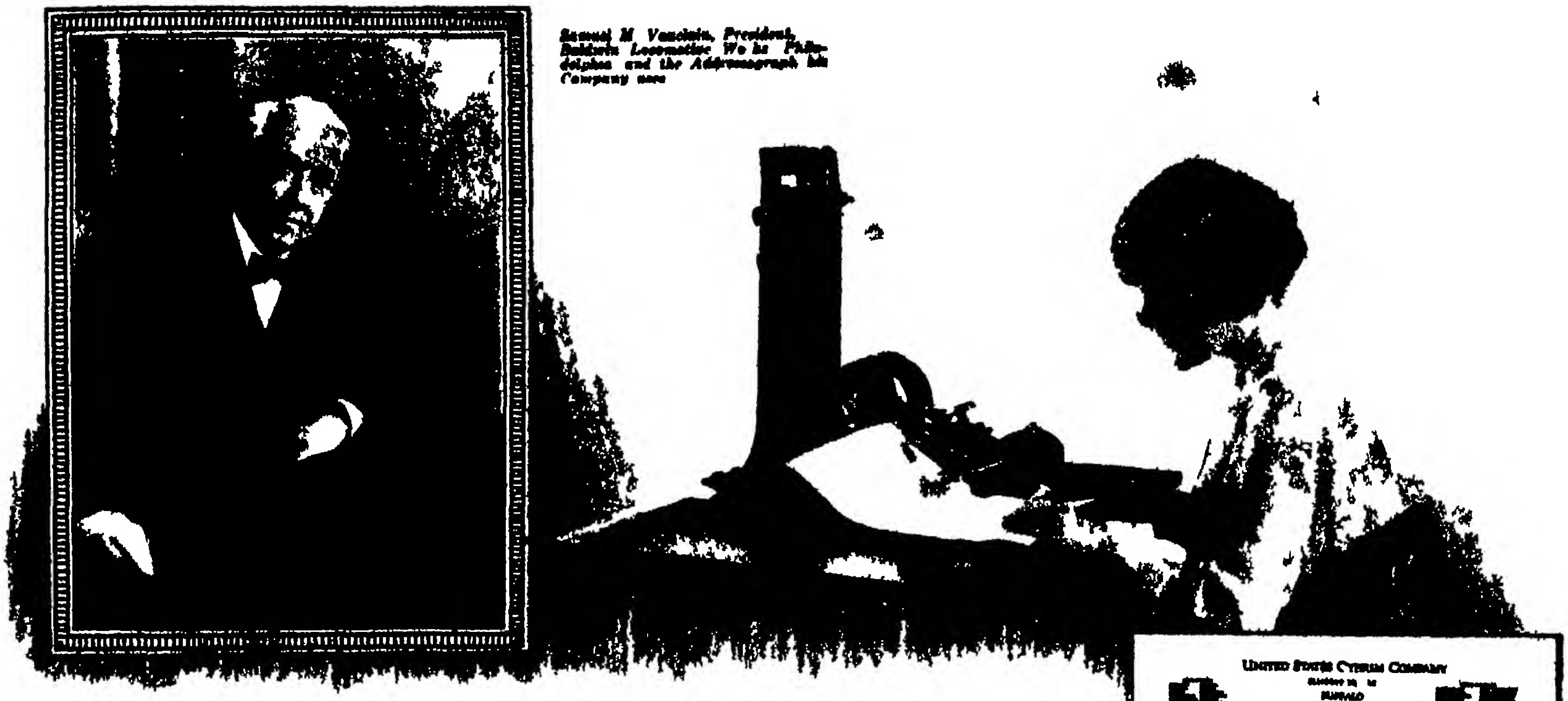
Everybody pages 375-379 / 384 / 428-431

ENTIFIC AMERICAN

Monthly Journal of Practical Information

Copy | JUNE 1922 | $4.00 a Year

BY LAND AND WATER WITH THE AMPHIBIOUS TRAINS OF BELG AN CONGO See page 74



—"a device that saves a $600 clerk saves the interest on $10,000.00!"

Samuel M Vauclain

(Published with full knowledge and approval of M Vauclain)

ONE preparation for real business that seems generally neglected today is *getting ready* to sell and produce at *lower* costs — states Mr Vauclain in April 8th issue of Collier's He continues There is not going to be any *real* business had under *old* methods or *old* costs—everything is of tomorrow! We spend for new machinery whatever amount seems justified

Take an employee receiving say $600 a year his (or her) wages *are the interest on $10 000* We can make a *profit* and *lower* costs by installing a device which saves the wages of one $600 a year man—even though the device costs $5 000!'

WHY BALDWIN LOCOMOTIVE USES ADDRESSOGRAPH—

For these reasons Mr Vauclain's Company, the Baldwin Locomotive Works has replaced slow tiring hands in its payroll department with a high speed Addressograph For the *same* reason the New York Consolidated Gas Company is saving 253 clerks in its billing work with Addressographs which are *entirely automatic* and 100% accurate

WINS BUSINESS—CUTS COSTS—

Not only famous corporations but small retailers and distributors are *profiting from* Addressograph advantages. The same $57.50 Addressograph used in 60 branches of the International Harvester enables F H Dunstatter Richmond Hill L I (retailer) to enjoy 400% *more* sales this Spring than last year Note how thousands of offices in 500 different lines use their Addressographs

MARKETING— filling in sales letters addressing circulars price lists, house organs sales bulletins

RECORDING— office and shop orders schedules inventory records, etc

SHIPPING— tags labels, waybills, invoices

STRAIGHT ADDRESSING mailing strips and wrappers for publications envelopes, cards etc

METAL IDENTIFICATION TAGS— for shrubs machinery etc (quickly embossed with Graphotype)

COLLECTIONS— heading and dating statements, trial balances collection letters installment, rental and premium notices and receipts etc

DISBURSEMENTS— dividend and payroll checks time cards and vouchers, pay envelopes and receipts, listing payrolls and dividend check recaps

ROUTING— factory or house orders, wagon drivers sheets publications, etc

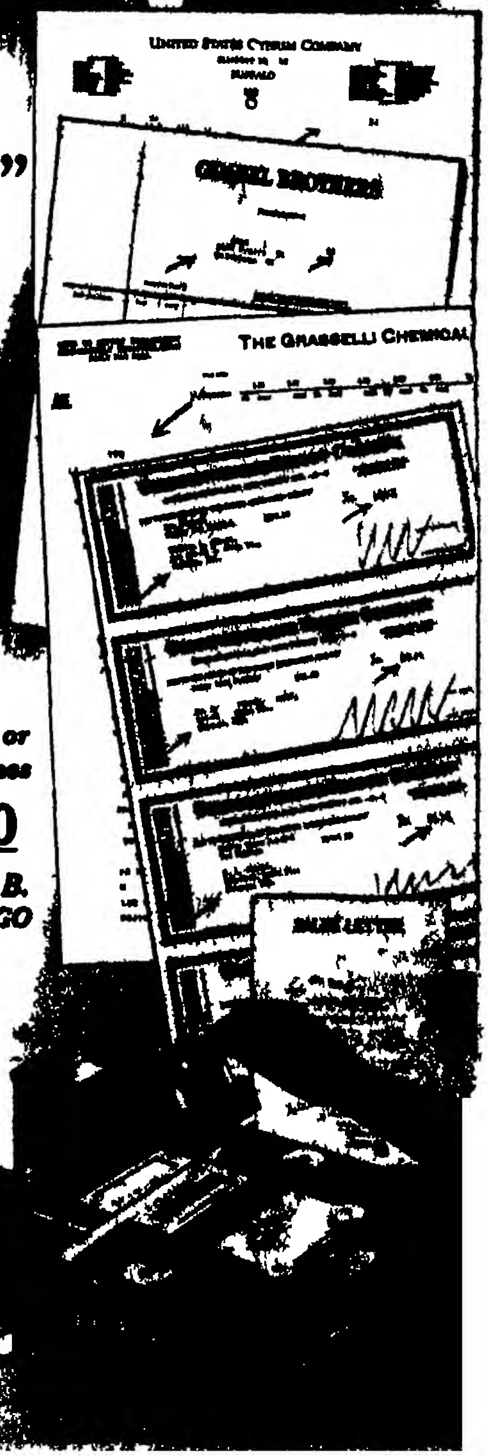
FREE TRIAL PROVES SAVING—

Savings you never realized possible will be found by the Addressograph Systems Man near you Let him at least *try!* *Free* trial of Addressograph will convince you! Coupon below brings interesting proof No obligation

Hand, Foot or Motor Machines

$57.50

and up, F O B. CHICAGO



Phone, Wire or Write Here.

General Offices 912 W Van Buren Street, Chicago — Factories Chicago, Brooklyn, London

Allentown, Pa
Albany N Y
Atlanta Ga.
Birmingham, Ala
Baltimore Md
Boston Mass.
Buffalo, N Y
Butte Mont.
Chicago Ill
Cincinnati Ohio
Cleveland, Ohio
Dallas Texas
Denver Colo.
Des Moines Iowa
Detroit, Mich
Duluth Minn.
El Paso, Texas
Grand Rapids, Mich
Houston, Texas
Indianapolis, Ind.
Kansas City Mo.
Los Angeles, Calif
Minneapolis, Minn
Newark, N J
New Orleans, La.
New York N Y
Omaha Nebr
Peoria Ill.
Philadelphia, Pa
Pittsburgh, Pa.
Portland Ore.
Salt Lake City, Utah
San Antonio, Texas
San Francisco Calif
Seattle, Wash.
Spokane, Wash
St. Louis, Mo.
St. Paul, Minn
Syracuse, N Y
Toledo Ohio
Washington, D. C.

Canada: 60 W Front St., TORONTO—Vancouver—Montreal—Winnipeg—London

Addressograph

TRADE MARK

PRINTS FROM TYPE

FREE TRIAL and FREE bulletins on—

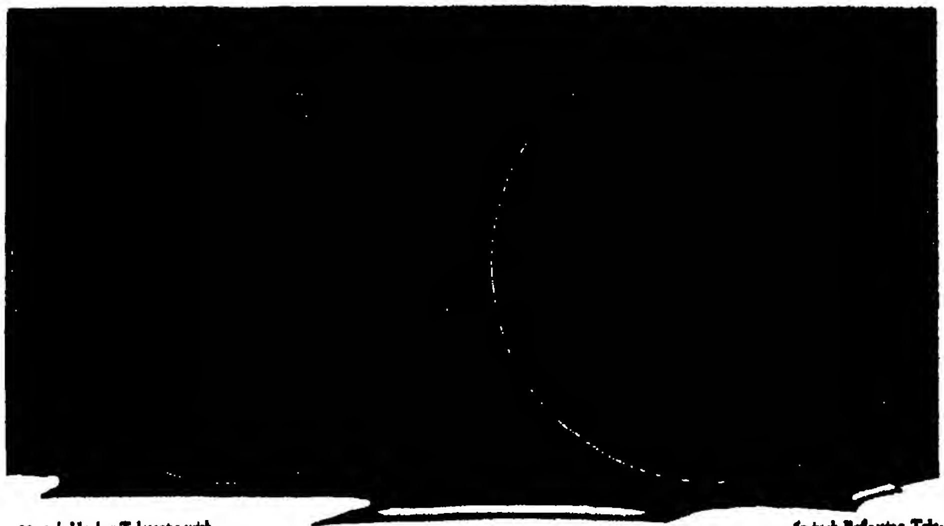
"Mailing lists that Pay," "Payroll short-cuts," "Quicker Collections," "Better cost records"

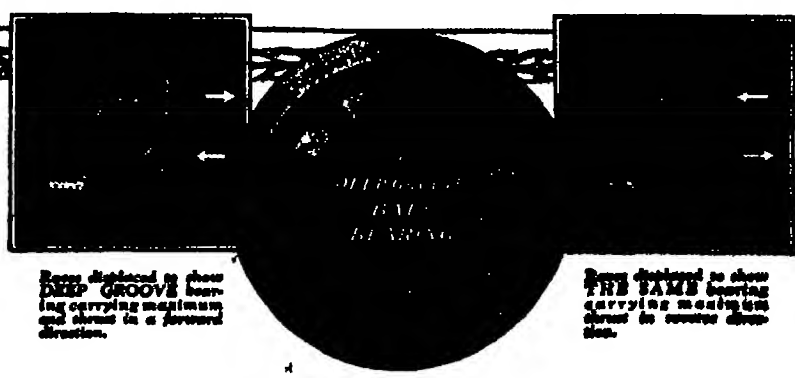
Just mail coupon

MAIL WITH YOUR LETTERHEAD

To Addressograph Co., 912 W Van Buren St. Chicago

Scientific American, June, [illegible] Volume [illegible], Number [illegible] Published monthly by Scientific American Publishing Company at [illegible] Broadway New York N Y Subscription price [illegible] per year. Entered as second-class matter June [illegible], 18[illegible], at the post office at New York, N Y under the act of March 3 1879





With the Editors

CONTENTS

June, 1922

LEADING ARTICLES

SHORTER ARTICLES

DEPARTMENTS

SCIENTIFIC AMERICAN PUBLISHING COMPANY
Munn & Company, 233 Broadway, New York
Founded 1845

CHARLES ALLEN MUNN President ORSON D. MUNN, Treasurer
ALLAN C. HOFFMAN Secretary

EDITORIAL STAFF
J BERNARD WALKER AUSTIN C LESCARBOURA J MALCOLM BIRD

DEPARTMENT EDITORS
ALBERT A. HOPKINS, Notes and Queries
ISMAR GINSBERG, Chemical Engineer
VICTOR W PAGE, Automotive Engineer
HENRY NORRIS RUSSELL, Prof of Astronomy, Princeton University

CORRESPONDENTS
C. H. CLAUDY, Washington, D. C. HECTOR C. BYWATER, London England
ALFRED GRADENWITZ, Berlin, Germany LEONARD W MATTERS, Buenos Aires, Argentine Rep.

CORRESPONDING EDITORS
H. DIEDERICHS, Prof of Experimental Engineering, Cornell University
SAUL DUSHMAN, Ph.D., G. E. Research Laboratory.
EDWARD ELLERY Consulting Chemist, Union College.
RALPH J. FOGG, Prof of Civil Engineering, Lehigh University
LEON A. HAUSMAN, Ph.D., Instr. in Protozoology and General Biology, Cornell Univ
HARRY S. HOWER, Prof. of Physics, Carnegie Institute of Technology
M LUCKIESH, Dir of Applied Science, Nela Research Laboratories.
ROY W MINER, American Museum of Natural History
H. F MOORE, Research Prof. of Eng Materials, Univ of Illinois.
W A MURRILL, Ph.D., New York Botanical Garden.
W G. PECKHAM, Prof. of Physics, Adelphi College.
H C. RAMSOWER, Director of Agricul. Ext. Service, Ohio State University
SAMUEL J. RECORD, Prof. of Forest Products, Yale University
JOHN RITCHIE, Massachusetts Inst. of Technology
J. HAMMOND SMITH, Prof. of Civil Engineering, Univ of Pittsburgh
EDWARD G. SPAULDING, Ph.D LL.D., Prof of Philosophy, Princeton University
G. A. YOUNG, Head, Mechanical Engineering Purdue University

Vol. 126, No. 6. Published monthly Entered as second class matter, June 18, 1879, at the post office at New York, N Y., under the Act of March 3, 1879.

Price, 35 cents a copy $4.00 a year. Postage prepaid in United States and possessions, and Mexico, Cuba and Panama; $4.50 a year for Canada. Foreign subscriptions, $5.00 a year postage prepaid.

SOME years ago we were in the habit of receiving contributions from Germany altogether in German, and among the correspondents who thus served us was Dr Alfred Gradenwitz. One day we got a letter from him, the gist of which was that he had concluded that he would serve us better if he sent his stories in English, that he was studying the language, and would shortly begin using it in his manuscripts. We awaited the event with some trepidation; the efforts of a Teuton to write in a foreign tongue which he has taken up for the first time as an adult are seldom very graceful When the first example of the new order of things arrived, we were agreeably surprised, we were of course able to touch up Dr Gradenwitz's text here and there, but on the whole he did it very well. And he has been doing it better ever since, barring a period when the British Navy wouldn't let him do it at all. We hope that our readers appreciate what it means to us and to them to have affairs in Germany covered in this way by a correspondent who writes in their own language, and not through the medium of an interpreter. Dr Gradenwitz is our only native correspondent in a foreign-speaking land who writes English, and when we tell you that his product almost always goes before you without any change, without any editing whatever, we think you will agree that he makes an excellent job of it

ONE of our trying tasks is keeping all our stories down to the essentials, in order that we may have space for all the stories that it is necessary for us to cover That this involves much skilful rewriting is evident. Less evident is the fact that it involves giving thought to other things than the text alone. It is surprising how much space is wasted in commercial and news photography — how much useless background and foreground and sides are included in a given photograph Thus, if the photographer is making a picture of an oil can, he is as apt as not to include the entire automobile engine or lathe or other piece of machinery that may be oiled. Yet the whole story is in the oil can, and just so long as there is a sufficient portion of the engine, lathe, or machinery shown to carry out the idea, it is not necessary to show very much of the useless trimmings, so to speak. A whole man need not be shown, for that is useless in the extreme. If we show the entire man, the cut or printing plate must be made of a very large size in order that the "meat" of the picture—namely, the oil can, will be sufficiently large to show what it is. And if we give so much space to a mere oil can, how can we ever cover our wide editorial scope? So it comes right down to a matter of trimming photographs—cropping them, as the parlance of the magazine shop and engraving shop has it. We trim off the useless foreground, the useless background, the useless sides, and so on, leaving the very heart of the photograph. If artistic merit is sought, then some of these otherwise useless trimmings may be left on. Often that dainty hand which you see on our inventions pages, holding a new dish mop, may be that of a beautiful girl, and much as we would like to include all of the beautiful girl on the 8x10-inch print, we feel compelled to crop off all but her hand—a mere two-inch square. Other times, however, it may not be the hand of a beautiful girl, hence the loss is trifling. But in all events this business of cropping is a very necessary one in gaining brevity, condensed pictorial treatment, and the greatest possible diversity in our columns.

FOR a long while back we have been fully cognizant of the many advantages of the motion picture technique over the written or spoken word, by way of reporting a given happening or explaining some new or old phase of science. The motion picture appeals to the mind directly through the eye For that matter, so does the written word which makes it superior to that extent over the spoken word. In addition the motion picture creates the images, it speaks in pictures, it leaves nothing to the mind to create. Its explanations take the form of a succession of animated pictures or cartoons or models The human eye sees those successive images, notes the changes or development or process, and the mind immediately grasps the full meaning of all these things with the least amount of effort To explain the operation of a radio receiving set step by step by means of the written word aided with photographs and drawings, is no simple matter and it may be considerably more difficult for the lay reader to follow and grasp the full meaning of what is written and illustrated Yet the same story, when told on the screen, is so much simpler Animation is supplied to the drawings and photographs, and such titles are inserted as aid in explaining certain parts of the story

MANY SCIENTIFIC AMERICAN stories can well be re-told in motion picture form for the reason that they require animation for a more ready understanding by the laity To this end we have entered the motion picture field, as producers of SCIENTIFIC AMERICAN films, in collaboration with the Coronet Films Corporation of Providence, R I The films, which will appear once a month will be released through the Education Film Exchanges, and will be shown in the better class theaters throughout the country Such subjects as can be treated to the best advantage in motion picture form will be taken from our columns and transplanted to the screen The complete details will be covered in these columns the thing itself will be featured on the screen, under the SCIENTIFIC AMERICAN title

ANOTHER piece of news! We have inaugurated a special radio-phone broadcasting talk of our own in order that we might report and comment on the scientific news of the day for the benefit of the radio audience For the present, our activities are centered in the Middle Atlantic States, but in the very near future we shall make arrangements to cover more or less the entire country with our radio talks. We are using the WJZ station of the Radio Corporation Westinghouse organizations, located at Newark, N J for our present broadcasting thus covering a range of several hundred miles. If you are within reasonable range of WJZ you can tune in to 360-meter wave length and listen in to the SCIENTIFIC AMERICAN radio-phone talks between 9 and 10 15 on Friday, May 19th, Tuesday, the 23rd Wednesday the 31st, and every Wednesday thereafter Let us hear from you if you receive our radio-phone talks, whether you are far or near Also send us suggestions as to what you would be interested in, and we shall endeavor to mold our radio talks accordingly

BUILDING RESUMES!

The photograph is of the new Statler Hotel at Buffalo N Y Type T panels will be used throughout this hotel

Westinghouse Type "T" (Tumbler) Safety Panel Boards meet lighting requirements of all kinds of buildings • • Parts stocked throughout the country • • Assembled without delay to meet all requirements Inexpensive but of the highest quality • • • •

These panel boards are adapted for use in large residences, hotels, factories, stores, office and apartment buildings, etc., etc.

The essential operating parts are made at the Brooklyn works. This insures the highest grade of product, as well as low cost because of quantity production methods. The parts are then shipped to the various Service Stations of the Company, which are located in principal cities all over the United States. Local orders are referred to these Stations, and are there made up from stock parts, without delay.

Type "T" panels are absolutely safe for the operator. Everything reachable is dead, so that shock is impossible. They have been approved by the National Board of Fire Underwriters.

Their material and workmanship are of Westinghouse high quality; they are good-looking; suitable for all panel uses; and their price is as favorable as the prices of panels possessing fewer advantages.

Leaflet and specifications on request.

WESTINGHOUSE ELECTRIC & MANUFACTURING CO. • *Offices in all Principal Cities* • Representatives Everywhere

Westinghouse

©W E AND M CO. [illegible]

SEVENTY-EIGHTH YEAR

SCIENTIFIC AMERICAN

THE MONTHLY JOURNAL OF PRACTICAL INFORMATION

NEW YORK, JUNE, 1922

United States Great Britain France Belgium Germany China Japan Italy Spain

How the wages of the building trades in the several countries compare, when reduced to gold The number of "coins" in each man's stack is directly proportional to his daily wage, the exact amount of which will be found in the text

The World's Wages—a Statistical Anomaly

STATISTICS sometimes are of the most absurdly misleading nature We thought it would be interesting to make a comparison showing how much labor an ounce of gold would buy in the various countries. It looked simple the comparison visualized itself and the article fairly ran out of the typewriter It was only necessary to order up a couple of hundred pounds of Government documents digest them and the figures would marshal themselves in orderly rows and columns But when we did it the results were so extraordinary that we thought our statistical hand had lost its cunning We are never too proud to seek advice when puzzled but expert advice only thickened the fog An appeal was taken to a great Government authority We omit his name because we promised to but we quote his reply in extenso

"If I were not a superman (which of course I am) I would be glad to know that somebody else has found out what a delightful thing it is to handle the statistical side of international economic questions at this particular time I fully understand your amazement at finding the wages of painters less in Germany than in China Apparently you do not believe it neither do I But mathematically and statistically it is correct if the fundamental basis is correct The first Commissioner of Labor, Carroll D Wright, undertook an investigation of criminality of cities by nationality The final returns showed the Chinese in the District of Columbia to be 900 per cent criminal! Naturally Colonel Wright wanted to know what idiotic clerk had worked out such a proposition as that He was told by his chief statistician that the statement was statistically correct that there was one Chinese in the district and that he had been arrested three times

If we apply the price that New York is willing to pay in American gold for the German mark your figures are correct The basic fallacy lies in trying to express wages and prices in a country undergoing a financial upheaval like that in Germany today in terms of the money of another country I think it true that in Germany today on the basis of the American dollar a painter is working for .. cents a day but in Germany today they are not buying or using gold—so why measure their prices in gold? To do so manifestly distorts the situation With existing conditions in Germany Italy even Belgium I think this explanation holds that to express conditions there in terms of our money which they are not using is essentially misleading But after all I may be wrong—you asked me for my opinion and here it is personally not officially

Notwithstanding this criticism we shall go right ahead and present the information we acquired so painfully Our foreign exchange quotations are those of February 25 On that date the British pound was worth $4 41 in gold the French franc 9 08 cents the Belgian franc 8 64 cents the Italian lire 5 17 cents the German mark 4 5 mils The less said about the Russian ruble the better its value depends on that of paper and ink In the Far East we have the Japanese yen which is fairly stable .. or 3 cents below its par value of 49 8 cents

In some of the figures there are gaps probably because the trade is so lightly represented that nobody has ever troubled to compile statistics For farm laborers the figures are necessarily more of a guess than for better organized and better standardized trades With these safeguards we present the figures for five ordinary vocations

The question at once suggests itself what is a "day?" Here again we strike a snag and can only say that the hours vary from eight to ten depending on the usages and on the strength of the unions if these exist.

(Continued on page 416)

Spain Italy Japan Germany Belgium France Great Britain United States

A similar comparison for the agricultural laborer. The stacks here are to be compared only with one another, and not with those of the upper strip, the German's wage having been taken as the unit in each case, and being different in the two branches

The North Atlantic Ice Patrol

How the Coast Guard Cutters Broadcast the Position of Icebergs to Shipping

THANKS to the ceaseless vigilance of the cutters of the United States Coast Guard, the recurrence of such a stupendous disaster as the loss of the "Titanic" through collision with an iceberg is a very remote possibility. It could only happen, indeed, through failure to pay close attention to the warnings of the ice patrol and practice quick compliance with its suggestions.

The loss of the "Titanic" was bound to result in efforts to provide against any similar disaster, and the many investigations which followed were directed to two separate fields of inquiry. First, there was the peril which lay in the faults of construction of the ship itself, faults which were common in all shipping of that day, and secondly there was the peril of the uncharted iceberg floating down from the north across the lines of steamship travel. The first peril was met by the organisation of the International Bulkhead Commission, whose findings resulted in a closer spacing of bulkheads and various improvements aimed to protect the stability of ships by limiting the inflow of water in case of under-water damage. Something was gained in this direction, but we could wish that the structural safety provisions had been carried further in the direction of raising the height of the bulkhead deck, and the insistence that it should be made watertight.

The recognition of the peril from floating icebergs led to a request by the maritime nations that the United States undertake the patrol of the ice-infested regions during the three months of the year—April, May, and June—which covers the southward passage of the ice. No time was lost in instituting this patrol, and the work was relegated to the Revenue-Cutter Service, now known as the Coast Guard, the other nations agreeing to pay a pro rata share of the cost of the service.

The Revenue-Cutter (Coast Guard) is very proud of its long history and its honorable traditions. It was established by an Act of Congress, approved August 4, 1790, and ten vessels were built and placed in commission by November 1, 1791. It is a curious fact that this constituted the only armed force of the United States afloat, thereafter, for a period of more than six years, or until the commissioning of certain vessels of our newly organised navy. The Coast Guard is organized as a military service. It has an academy at New London, Conn., for training and instruction of cadets, and warrant officers are drawn from the enlisted force, by selection for fitness and general qualifications. The equipment consists of thirty-one cruising cutters, including five "Eagle Boats" of doubtful value, twenty five harbor cutters, twenty-two launches, and two hundred and seventy-three Coastal and Great Lakes Stations. Also, the Service owns eighty five self bailing, self righting life boats, driven by gas and sail; three hundred and eighty self-bailing surf boats, driven by gas and oars, and five hundred and thirty boats of other types.

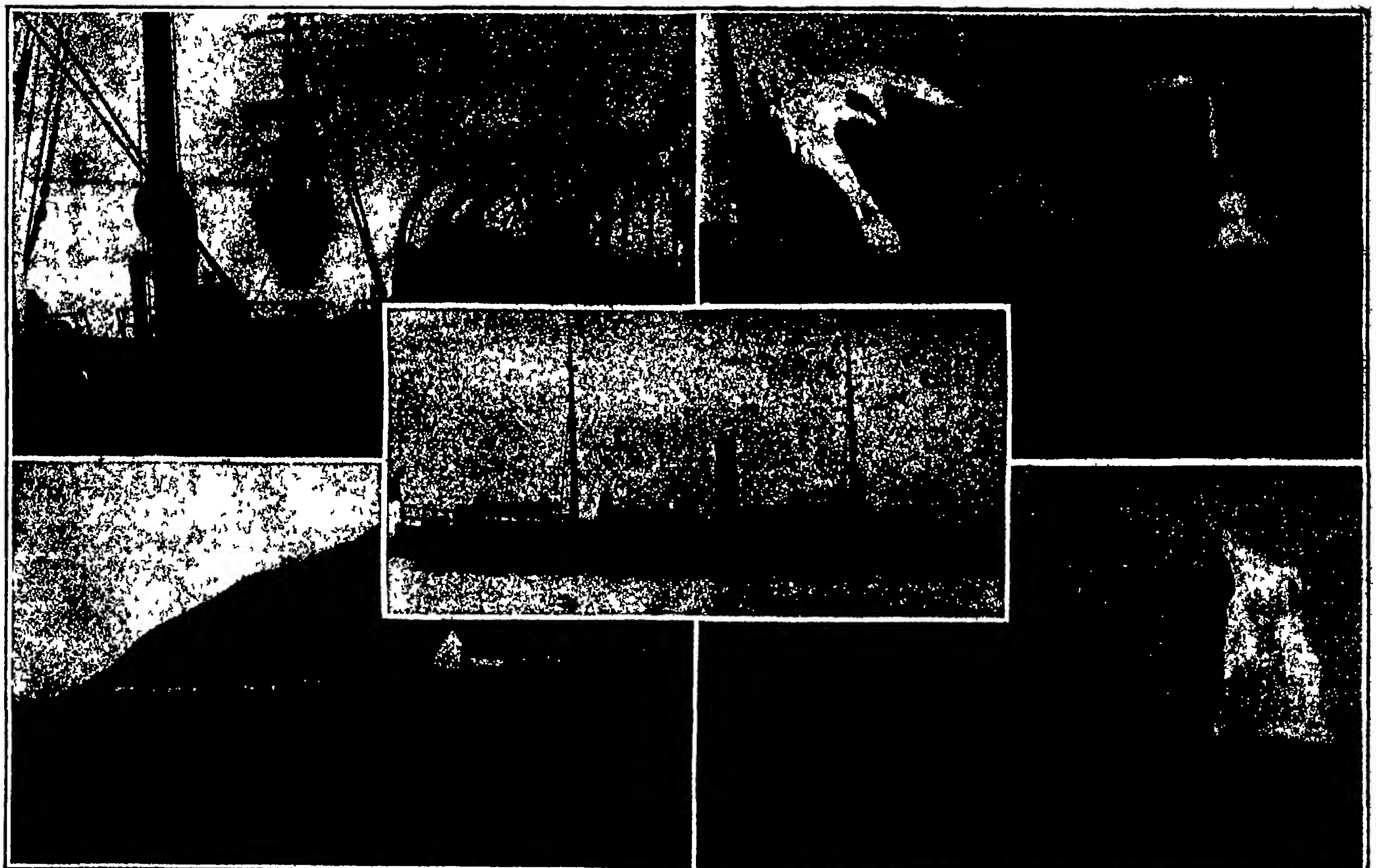
The duties of the service are many, including assisting vessels in distress, destruction or removal of derelicts, protection of customs revenue, regulating the anchorage of vessels in navigable waters, enforcing quarantine and neutrality, suppression of mutinies; enforcing navigation laws covering merchant vessels and motor boats, protection of the seal fisheries; patrol of western rivers for rescue of life and property during floods; and finally the patrol of the Grand Banks off Newfoundland for the protection of shipping from ice fields and bergs.

It is a very active service, as may be seen from the report for the year ended June 30, 1917, covering the last of the pre-war activities, and the months of the war between April 6th and June 30th of that year. During that time 2158 lives were saved, or persons rescued, and 18,796 persons on board vessels were assisted; 11 derelicts were removed or destroyed, and the value of the vessels assisted, including cargoes, was $14,960,910.00. It should be mentioned that in the one item alone of marine property saved, the service returned in that year $2.88 for every dollar expended in its maintenance.

We question if in any service is to be found higher quality, whether above or below decks, on the bridge or in the engine room, than for many years has marked the Revenue-Cutter or Coast Guard Service. The personnel, because of the frequent life-saving and ship-salvaging work which it has to do, is marked by the careful selection of the enlisted men, of whom it is required that they shall be of good physique, and that they shall be every inch "sailormen." It is probable that in no service is there to be found, today, so much of the real old seamanship, particularly in the handling of boats in heavy weather, and in landing, whether alongside a disabled vessel or on a storm-beaten coast.

The Coast Guard fleet has recently been improved and increased by the addition of four fine vessels, the cutters "Tampa," "Haida," "Mojave," and "Modoc;" and judging from our illustration of the "Tampa," the first of these to go into commission, they are all very shapely craft, with a handsome sheer, good freeboard, and a well-designed midship deckhouse and bridge structure, which with its tumblehome (if we may use the term), harmonizes agreeably with the general ship's structure.

The most novel feature of this ship is that she is equipped with the electric drive. The dimensions of the "Tampa" are length overall 240 ft., breadth 39 ft., and mean draft 14 ft. 2 in. She is driven by a General Electric, Curtis-type turbine. This is direct-connected to a main generator of the alternating current type. The main motor, of the synchronous type, drives a single



Upper left. Coast Guard Cutter towing a sailing ship out of a sea of dangerous ice. *Upper right:* A berg melting and breaking up off the Grand Banks. *Center:* The "Androscoggin," Coast Guard cutter from whose deck these photographs were taken. *Lower left:* Now and then the crew of the cutters land on some bleak northern coast to drill and stretch their legs. *Lower right:* A berg with cutter "Maine" keeping in touch and broadcasting its position to Atlantic shipping

eighteen-foot propeller. The speed of the "Tampa" when loaded is sixteen knots; and since maneuvering ability is of prime importance in a Coast Guard cutter, it should be noted that by the reversal of her motor she can be brought to a dead stop within her own length, or within less than two hundred and fifty feet.

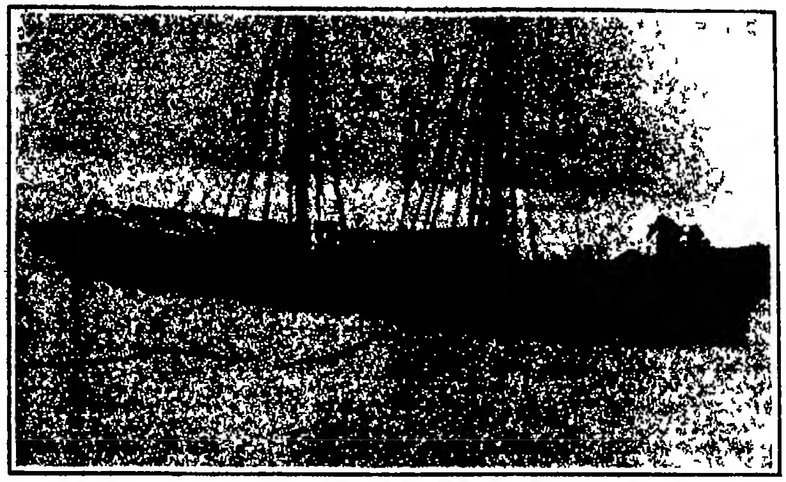
The west coast of Greenland is the birthplace of the justly dreaded icebergs. This great peninsula is almost completely covered with a heavy ice-cap, and, bearing in mind that there is little or no melting from the snows in the high latitudes, the accumulation from the annual snow fall is very large. This mass, compacted to the consistency of ice and following the lines of least resistance, flows steadily down the valleys to the sea. Here the glacier, frequently many hundreds of feet in vertical thickness, protrudes out into the waters until it breaks off by its own weight, and floats wherever the currents and the winds may carry it. For one-ninth of its bulk exposed, eight-ninths lie below the surface of the water. Ultimately these bergs reach the great Labrador current, and their movement is as shown in our illustrations. They travel at a rate which varies from 0.3 knot per hour, in the early spring, to 0.7 knot per hour later in the season.

To anyone blessed with imagination, this grand procession of icebergs, through a distance of over two thousand miles, from the region of Smith Sound, in latitude 78° north, to the Southerly Tail of the Great Bank of Newfoundland, in latitude 43° north, presents a most majestic and wonderful phenomenon.

Were it not for the existence and persistence of the warm waters of the Gulf Stream, the peril of ice in the late spring and early summer would be much greater than it is. This stream passes out of the Gulf chiefly by way of the Straits of Florida, and flows in a N.N.E. course to Cape Hatteras, which it passes at a distance of about twenty miles. Thence its general course is E.N.E., and it widens out, passing to the south of the Great Bank of Newfoundland, where it meets the cold waters of the Laborador current above mentioned. From the Great Banks it broadens out to lose itself finally on the northwestern coast of Europe, whose climate it very materially affects.

By a study of the accompanying map, it will be seen that, after passing down the coast of Labrador, the icebergs are deflected by the great shoal known as the Newfoundland Bank, and pass in a general southerly direction along its easterly contour. Not all of them, however, for some ground upon the Laborador coast, and others upon the northern slopes of the Great Bank. Those which are not caught and anchored in this way continue down to the Tail of the Bank, and it is these bergs that constitute the grave peril to shipping, for once they have passed the Bank, they float out into the steamship lanes, where, in waters that are most of the time covered with more or less dense fog, they constitute a terrible and ever present menace.

The movement of the icebergs after reaching the Tail of the Bank, is, generally speaking, as follows. They are carried south until they encounter the warm water of the Gulf Stream, when they are rapidly turned back to the northeast. They may return in a back eddy later in the season, or they may be carried north, and there frozen with the salt water ice, to go south again as early arrivals the following year. As a general rule they "cave" and split into smaller bergs, and melt rapidly in the Gulf Stream waters. We present a chart published by the Hydrographic office showing the actual course taken by a large berg sighted by the ice patrol four different times during the single month of April, 1921. The office states that this berg was unmistakably identified by photographs taken from the Coast Guard patrol ships, and by other means, and its track accurately computed and plotted. The Bureau requests that navigators make a careful study of this chart, since the drift is typical of the majority of icebergs in the North Atlantic, near the steamship tracks. The oval track drawn to the left of the second sketch of the berg, shows the route of another berg to the southwestward of the Great Bank, in the period of May 20 to June 4, 1921. Its track measured 150 miles across its greatest dimension and the drift indicates the existence at that time of one of the typical ocean eddies which are to be found in that locality and which never maintain the same size boundaries, or positions.



Cutter "Androscoggin" found this schooner fast in the ice

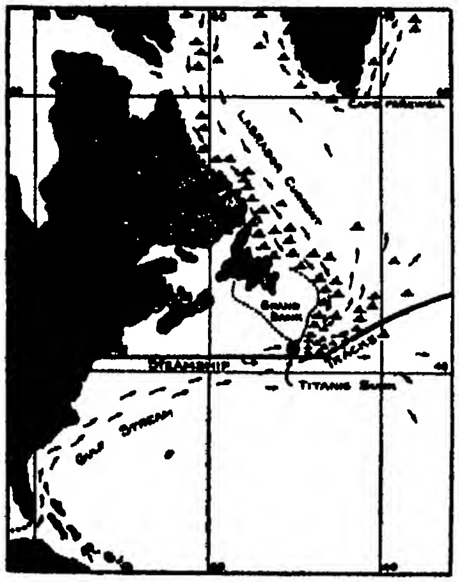
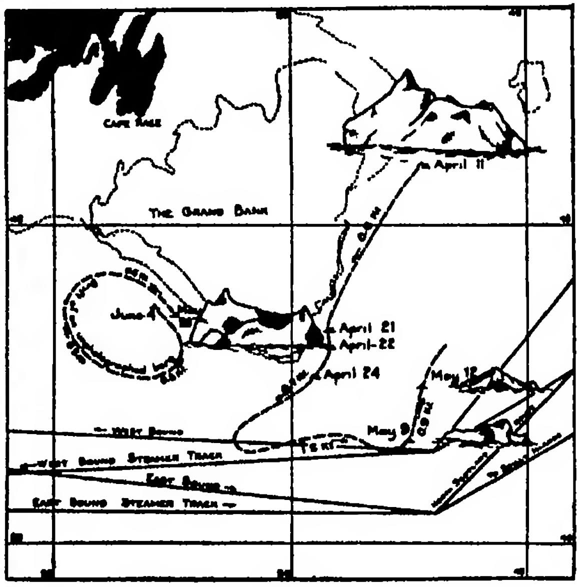


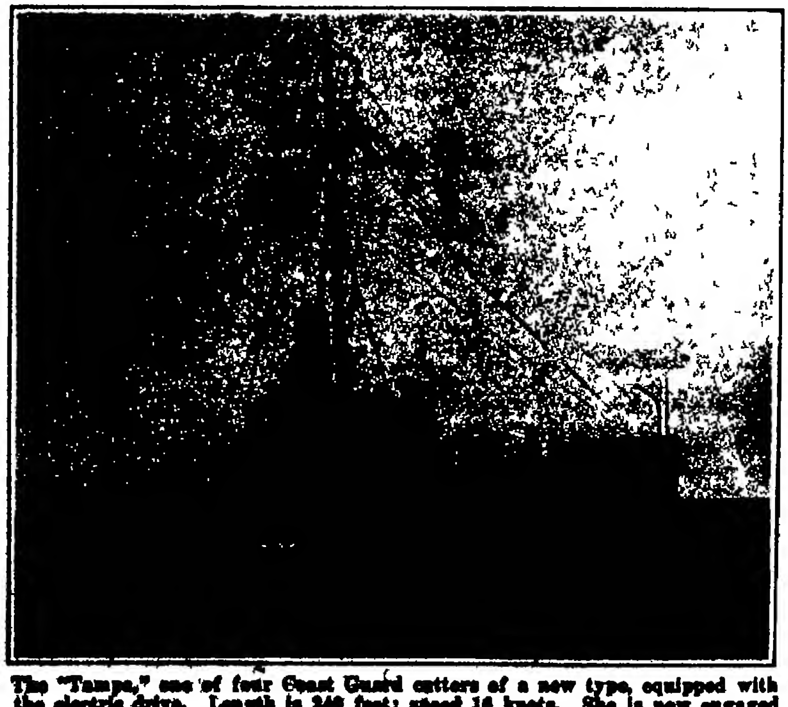
Chart showing icebergs carried by Labrador current into steamship tracks



This iceberg was sighted April 11 and its course plotted until May 12, when it disappeared

The co-operation of the patrol vessels of the Coast Guard and the Hydrographic Office during the eight years of the Ice Patrol has resulted in the accumulation of a large amount of data respecting the course followed by the icebergs, and the limits of their southerly drift across the steamship lines. As the information is received it is made public in the weekly Hydrographic Bulletin and in the monthly Pilot Charts. Also the ice conditions are regularly broadcasted by wireless, both from shore stations and from the ships on patrol in the ice-infested waters. The boundary line between the Labrador current and the Gulf Stream is very variable, and on May 15 1920, it was found to be 70 miles south of the position of the boundary line on May 5, 1914, and over 150 miles south of its position at about the same time in 1913. The thrusting of the Gulf Stream to the southward involves, of course a more southerly course of the icebergs, and with a view to minimizing the risk to Trans Atlantic shipping the Hydrographic office has made arrangements with the steam ship companies by which, upon notification from the office, the headquarters of the companies in New York immediately notify the ship captains to follow a steam ship track during the ice season of April May, and June, 150 miles to the south of the normal tracks.

The records of the Hydrographic office show that during 1921 there were at times as many as ten bergs scattered along the line dividing the cold waters of the Labrador current from the warm waters of the Gulf Stream. Sometimes freak bergs, or "sailors," acted upon by the prevailing winds from the north will drift down across the Gulf Stream. As a matter of fact it is recorded that icebergs have been sighted as far south as the Azores and the Chesapeake Capes. This, however is a rare occurrence. In the majority of cases when a berg enters the Gulf Stream it rapidly breaks up and disappears. During the present season of 1922 the patrol is being carried on by two of the new electrically driven coast guard cutters, the "Tampa" and the "Modoc" which relieve each other at fortnightly intervals. The temporary home port is Halifax and each ship spends seven days on patrol, and seven days on the journey in and out to this station and in that port, refueling and taking on new supplies.

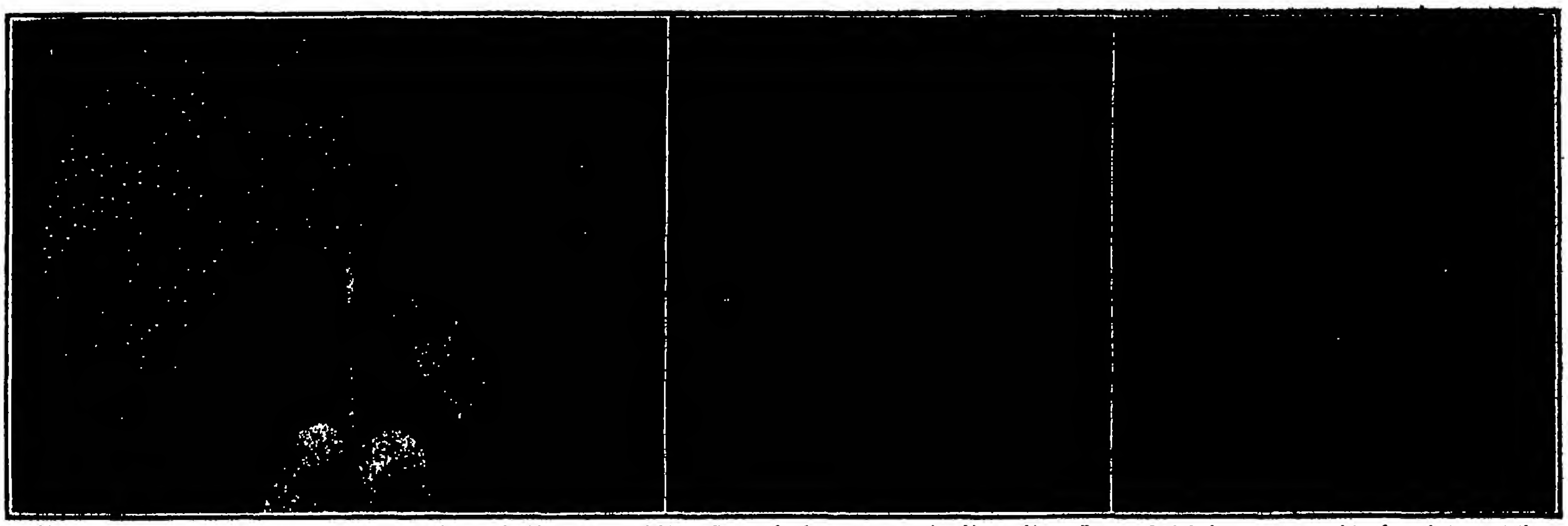


The "Tampa," one of four Coast Guard cutters of a new type, equipped with the electric drive. Length is 240 feet; speed 16 knots. She is now engaged on the Ice Patrol off the Grand Banks

We have before us extracts from the logs of some of the patrol vessels, which show that this service is no summer picnic. Much of the time is passed in dense fog and fierce gales, which frequently necessitate heaving to. Here are some notes from the log of the "Tallapoosa," as written down during her cruise May 15 to 30, 1919 and embodied in the report of the commanding officer —

"Ice warnings were broadcasted daily at specific times, beginning May 15th, with a

(Continued on page 436)



1 If we could magnify the point of a pin a billion-fold, we should find that a billion billion molecules can rest comfortably on this small area. 2 A hydrogen atom consists of an electron rotating about a positive charge (the nucleus) 3 A hydrogen molecule is formed by the combination of two atoms. The electrons rotate about an axis joining the nuclei, and are shown in perspective

How the simplest molecule is formed, something about its size, and the structure of the atoms of which it is built

Beyond the Microscope

A Scientific Motion Picture Film That Depicts the Structure of the Atom

By S Dushman, Ph.D, Research Laboratory, General Electric Co

Contributing Editor, Scientific American

FOR years those elusive and little-understood particles of matter—the molecule, the atom and the electron—have existed to all practical purposes only in research laboratories, surrounded by test tubes, vacuum bottles, and the mathematical formulae of the scientist When now and again their names have been mentioned in the news dispatches that go before the great public, it has been indicated that they play a large role in the every-day affairs of mankind, but just what this role was, or just what the molecule, the atom and the electron themselves were, has not been made clear to the uninitiated The need of a wider appreciation of the laws governing the behavior of these infinitesimal realities has increased in proportion to the knowledge which the scientific workers have piled up about them As a means of bringing about this wider appreciation, the molecule, the atom and the electron have gone into the movies, under the personal conduct of the heads of the General Electric Research Laboratories at Schenectady "Beyond the Microscope" is the title of a film prepared by C F Batcholts of this company, which is the first attempt to portray in a vivid manner some of the prevalent concepts regarding the structure of matter. The story of this film and of the scientific facts and researches behind it is told on these pages by Dr Dushman, one of those most involved in the laboratory work which preceded its production.—The Editor.

WE intend to discuss in this article some of the interesting features of the new views regarding atoms and to illustrate the discussion with still pictures taken from the film referred to in the Editor s note.

Of course, as most people know, we cannot see an atom With even an extremely powerful microscope the smallest particles we can see are at least one thousand times larger in diameter than even the largest of molecules.

Yet we are just as certain of the existence of molecules and the atoms, of which molecules are made up, as we are of the existence in each of our bodies of certain organs, although we have never seen them. In both cases, the evidence is what is known in law as circumstantial and, for lack of space we shall take it for granted that all matter consists of molecules and atoms

We know a great deal about these atoms and molecules. Thus the smallest drop of water (about 1/20 cubic centimeter) contains so many molecules that if these were each enlarged to the size of grains of sand capable of passing through a 100-mesh sieve, they would form a roadway from New York to San Francisco approximately half a mile in width and one foot in height The molecules are so small that as shown in Fig 1 one billion billion could rest comfortably on the point of a pin, 1 mil in diameter

Or perhaps the best figure is that employed by Aston in his recent popular lectures. Suppose we had means of separating out the individual molecules in a glass of water and labeling them so that we might recognize them again. Suppose then we emptied the glass into the oceans, after millions of years had elapsed to mix the water from our tumbler thoroughly and uniformly with that of the seven seas, suppose we came back and took at random a fresh glass of water from the ocean—we would find in it no less than 1,000 of our labeled molecules. That is to say, the glass of water is to the individual molecule as the combined oceans of a thousand globes like the earth would be to the glass of water

It is difficult to imagine that such a small particle can have a structure of its own. In fact, the word "atom" is derived from a Greek word signifying "indivisible," but while we still adhere to the term atom, we must, in the light of present knowledge, forget about the indivisibility But we have all kinds of evidence that the atom is made up of still smaller particles which are nothing else than positive and negative electric charges. Since matter, under ordinary conditions, is electrically neutral, the numbers of positive and negative charges in any one atom are equal, but the actual number of each kind of charge differs from one kind of atom to another The atom of hydrogen has the simplest structure of all. As shown in Fig 2, it consists of a single negative charge, or electron, as it is designated, which rotates around the positive charge or nucleus. The electron itself is probably about a thousand times smaller in diameter than the atom Its mass is about 2,000 times smaller than that of the atom.

Since a billion billion atoms of hydrogen more or less would hardly be noticed on the most sensitive balance, this means that the mass of the electron is indeed very small

It follows that practically the whole mass of the atom is concentrated at the nucleus. Yet this nucleus is at least 100,000 times smaller in diameter than the atom

The electron constitutes the ultimate unit of electric charge. Electrons streaming through a conductor constitute what we measure as electric current. Prof. R. A. Millikan has measured accurately the charge carried by an electron, when, for instance, a 40-watt lamp is run on a 120-watt circuit, there are 2 billion billion electrons passing into the filament, per second, at one lead and the same number leaving it, per second, at the other lead.

The hydrogen atom consisting of a single electron rotating around a positive nucleus of unit charge has a fairly large stray field of force around it. Consequently two atoms of hydrogen combine very readily to form the hydrogen molecule, shown in Fig 3. The electrons now rotate around an axis formed by the line joining the two nuclei

Hydrogen is the lightest of all elements. As we pass to the other elements, we find that the number of positive charges on the nucleus, and consequently the number of electrons around the nucleus, increase regularly Each element can be thought of as being built up from the element just below it by the addition of one electron and one positive charge on the nucleus. Thus helium consists of two electrons and a nucleus of two unit charges, lithium has three electrons and a nucleus of three unit charges, and so forth. The heaviest atom known, that of uranium, has 92 electrons and a positive charge on the nucleus of 92 units. The most recent theory regarding the arrangement of these electrons around the nucleus in the different atoms, is that suggested by Dr Langmuir This theory, which is a development of some earlier speculations of Prof G N Lewis of the University of Berkeley, California, postulates that the electrons are arranged in shells with the nucleus as center and that arrangements of two and eight electrons are extremely stable. In the simplest atoms, those of the hydrogen and helium, there is only one shell. With the addition of a third electron, a new shell begins to form This shell is completed when it contains eight electrons, which may be considered as located at the corners of a cube. The atom thus obtained is that of neon, a gas which has properties quite similar to those of helium. Both are absolutely inert chemically, gases at ordinary temperatures, and very difficult to liquefy, which is in accord with the theory that a shell of eight or one of two electrons is a very stable arrangement. On the other hand, an atom containing less than eight electrons in the second shell is quite active chemically

Thus lithium, with only one electron in the outer shell, is extremely electro-positive, since it tends to give up this extra electron. This leaves only the inner shell of two electrons and a nucleus of three positive units. The arrangement of electrons is thus similar to that obtained in the helium atom. The only difference is that the latter is electrically neutral, while the lithium atom which has one electron removed has a residual positive charge of one unit. It is known as a lithium ion, and is present in aqueous solutions of lithium salts, thus accounting for the electrical conductivity of such solutions.

On the other hand the fluorine atom has one electron and one positive charge less than neon. When fluorine is combined with lithium it completes the external shell

of other elements by taking the extra electron from the lithium atom. Fluorine is therefore said to be electro-negative, and the fluorine ion has the same arrangement of electrons as neon, but since it has a nucleus with only seven positive charges, the resultant charge on the ion is negative.

If a solution of LiF (lithium fluoride) is electrolyzed, the positively charged lithium ion goes to the cathode (negative electrode) and the negatively charged fluorine ion goes to the anode.

When one electron is added to the atom of neon, a third shell begins to form. The atom of sodium contains 11 electrons, and, like lithium, is electropositive. As more electrons are added, we obtain less strongly electropositive elements and with 7 electrons in this shell, we obtain the atom of chlorine, which resembles that of fluorine. On the addition of one more electron, we again obtain a stable, chemically inert atom, that of argon.

The fourth and fifth shells contain 18 electrons each. In each case the atom corresponding to the completed shell is that of an inert gas resembling helium, neon and argon. Thus the atom of krypton consists of five shells or layers, and has a total of 2+8+8+18+18=54 electrons.

Fig. 4 shows a model which may be used to illustrate the arrangement of electrons in any of the atoms of the first (that is lightest) 54 elements. It consists of miniature lamps, each of which is connected to a switch shown on the switchboard at the right. The nucleus is indicated by a red light at the center, and different colors on the lamps are used to bring out more sharply the different layers of electrons.

Fig. 4. The atomic model which, by lighting any desired combination of its 54 surrounding lights together with the central lamp representing the nucleus, may be made to serve as a model of any of the 54 simplest atoms

It was obviously impossible to represent on a film the motions of the electrons in these more complex atoms. Moreover we do not know very much about the actual motions of the electrons. The positions of the lamps in the model are to be taken more as indicating average locations than as fixed positions of the electrons. In order to illustrate in the film the mechanism by which compounds are formed, a simpler case was chosen, that of the combination between hydrogen and oxygen to form water In this reaction an atom of oxygen combines with a molecule of hydrogen.

We have already discussed the structure of the hydrogen molecule. The oxygen atom is illustrated in Fig 5 The electrons here are arranged in two shells. The inner shell has the structure of helium, that is two electrons near the nucleus. The outer shell has six electrons arranged at the corners of the imaginary cube described already Altogether there are eight electrons and the nucleus has a positive charge of eight units. It is evident from what has been stated above, that in order to complete the outer shell, two electrons are required. These are furnished by two hydrogen atoms, that is, one molecule of hydrogen As these electrons enter into the vacant corners of the cube, the nuclei of the hydrogen atoms tend to place themselves symmetrically with respect to two corners. Owing to the attractive forces exerted, the electrons at these corners are pulled in and the cube becomes distorted into the form shown in Fig. 6. In this figure, the nuclei of the two hydrogen atoms and that of the oxygen atoms lie on the axis shown by the dotted line, while the electrons presumably revolve about this axis and also two other axes (indicated by dotted lines) at right angles to that joining the nuclei Of course, this particular kind of motion of the electrons is hypothetical, but it is quite probable that the electrons are not absolutely stationary

The transition from this representation of the molecule of water to the more conventional formula Fig 7 is evident In electrolysis, one of the hydrogen nuclei tears itself away from the molecule and as hydrogen ion (with unit positive charge) travels toward the cathode, while the residual part of the molecule, as negatively charged —OH ion, travels toward the anode

When water is evaporated, we obtain steam The molecules which were quite crowded together in the former case are now separated by fairly large distances, and their continual impacts on the walls of the vessel produce the effect of pressure

In water itself, the molecules are quite mobile, but when water freezes to form ice or snow, we find these molecules assume regular crystalline arrangements and the most beautiful creations in nature are those which are exhibited by snow flakes.

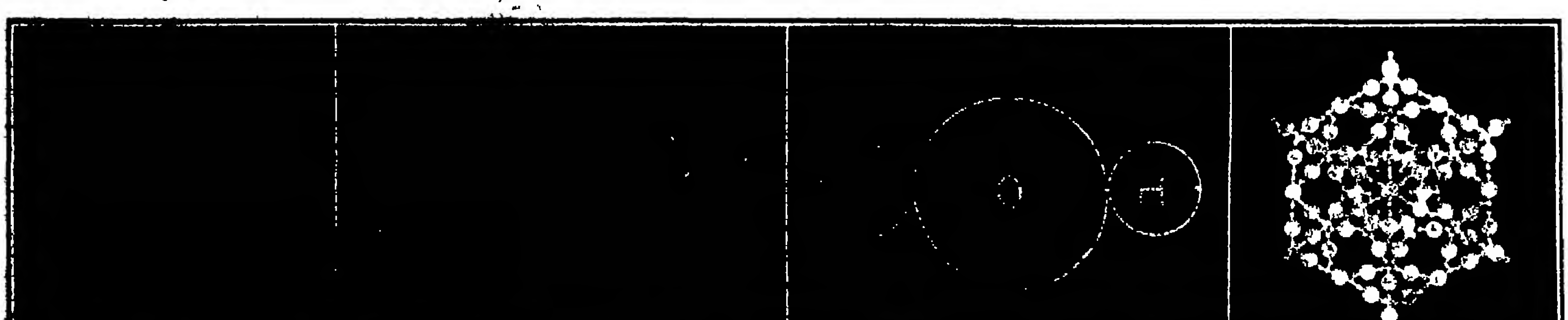
It is unfortunate that we cannot reproduce on the printed page the actual motion of the film We believe that we have made as advantageous as possible a selection of our stills but no set of stills ever does full justice to a film The film, made on the animated cartoon principle, gives a startlingly vivid representation of the behavior and the constitution of two of the simplest atoms. To attempt to represent in a similar manner the motions of electrons in some of the more complex atoms and the manner in which these atoms combine to form compounds would, indeed, be quite a task for even the motion picture artist

Bat Guano in Austria

MUCH interest has been aroused in Austrian agricultural circles by the discovery that many of the hundreds of caverns found in the Austrian Alps contain valuable deposits of bat guano and other phosphates of animal origin The government has passed a law retaining these under the control of the state and has been having official analyses of the deposits made and experiments as to the best method of preparing them for use as fertilizers. It has already been officially estimated that the Cave of the Dragon in Styria is capable of yielding 50,000 tons of granular phosphate of very homogeneous character this contains 41 per cent of phosphate of lime 25 per cent of carbonate of lime, and 34 per cent of readily attackable silicates. These fertilizers are now being systematically distributed in the different parts of Austria to be used in replacing bone dust, etc

New Studies of Caries in Teeth

THE alarming prevalence of caries in the teeth of civilized nations is a matter of universal concern Some new and rather surprising light is thrown upon this subject by recent investigations conducted in the laboratory of the hygienic institute of the University of Leipzig Perfectly sound teeth taken from various individuals between the ages of 18 and 55 years were employed in the experiments. Not the slightest flaw was to be found in any of these not even with a magnifying glass For the purpose of the experiment each tooth was covered with a layer of wax, in which apertures were then made at one point or another after which the tooth was immersed in a mixture of bread and saliva, at a temperature of 37 degrees Centigrade At the end of a week half of this mixture was removed and replaced by a fresh mixture of the same sort, in order that the conditions usually present in the mouth of a mixture of fresh food and saliva, together with decomposition products of former mixtures, might be reproduced as closely as possible The first traces of caries became manifest in a deeply grooved incisor, softening and discoloration was shown in this tooth even after the lapse of 33 days. At the end of 56 days all the other teeth exhibited signs of softening while completely developed caries was exhibited in all at the end of 124 days. The caries was produced at the selected points, whether these were covered with enamel or were at the "neck" of the tooth According to Professor A Seitz, who discusses the matter in the *Münchener medizinischer Wochenschrift*, the caries produced in this artificial manner is precisely like natural caries, showing all the stages thereof Strange to say, however the common belief that marmalades and similar sweets are largely responsible for the spread of caries was not confirmed While mixtures of bread, saliva and marmalade produced caries in about the same length of time as the first mixture (of bread and saliva alone) teeth placed in mixtures consisting only of marmalade and saliva showed no alteration even at the end of 61 days. It appears, therefore, that both the preformed acids and the traces of natural fruit acids of the marmalade are without effect in the production of caries"—*Abstracted from Die Umschau*



5. The oxygen atom, with its eight electrons. Two of these are quite close to the central nucleus, while the other six are at corners of an imaginary cube Two of these corners are blank and the atom enters into chemical combination with other atoms by allowing electrons of these atoms to fit into the empty places. 6. Formation of water from two hydrogen and one oxygen atoms, as described in detail in the text. 7. The conventional symbol for the molecule of water, indicating its structure of hydrogen and oxygen atoms. 8. A typical snowflake, showing how the beautiful crystal structure is pieced together by appropriate arrangement of molecules

Further stills selected from the motion-picture story of the atom

Three views of the Goldschmidt amphibious train as it appears in the water and on rails. The left-hand view shows the train on the inclined rail, entering the water. The center and the right-hand views show the train on the monorail

By Rail and By Water

The Combination Train and Tow Barges Invented by a Belgian Engineer for Use in the Congo

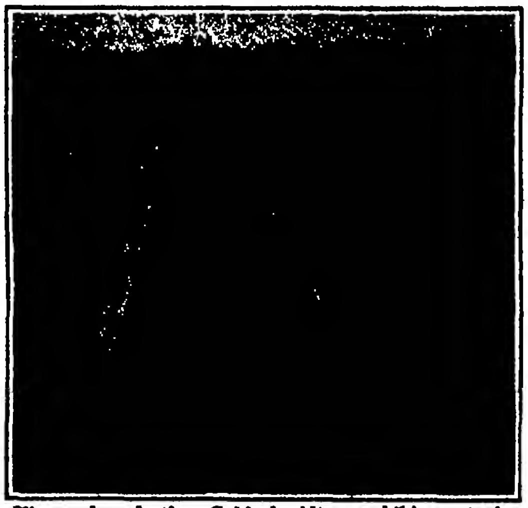
NATURE has little consideration for commerce. Thus, as often as not, we find tremendous stores of natural wealth tucked away in some remote and inaccessible corner of the world, where they must lie until a more fortunate day, when the problem of transportation is solved, or again until other stores of similar materials nearer to the markets are exhausted

A most striking case in point is the Belgian Congo, in darkest Africa Here are to be found rubber, rare fruits, metals, nuts, and so on, all of which have a ready sale in the markets of the world. But these stores of natural wealth are located far up the Congo River which, although navigable in stretches, has many rapids and other barriers to navigation on anything like a commercial scale Such railroads as exist in this far off land are of little consequence, not only as regards the territories which they serve, but more particularly in their mechanical limitations. In sparsely settled regions such as the Belgian Congo there is no doubt but that water transportation must always be cheaper and better than the railroad, but how can we navigate a river that is broken up into separate navigable stretches of water, with rapids, swamps, flats, and rocks intervening?

Two methods of solving the Congo transportation problem and releasing the natural wealth for the benefit of the entire world have presented themselves in the past The first is to undertake the gigantic engineering task of making the river navigable from the Atlantic Ocean to the regions containing the natural wealth in question Boats of at least 600 tons would have to be accommodated by the river in order to make commercial transportation profitable An English engineer, Wall, who has carried out numerous large engineering undertakings in South Africa, has suggested a plan for rendering the river continuously navigable between Matadi and Leopoldville. This plan calls for the cutting of a number of canals at certain points, these canals being provided with inclined railways for raising the boats out of the water, carrying them over the land, and lowering them back into the water again on the farther side Another feature of the enterprise would be certain changes in the river bottom, involving among other things the removal of over 1,300,000 cubic yards of rock All in all, the proportion of navigable sections as against unnavigable sections is nine to one, and the cost of bringing about continuous navigation is well out of the question at this time.

The second method that has presented itself is to leave the river as it is and to develop some form of combination water-and land transport To make this scheme practical, it is necessary of course, to load the carriers at some interior point and then carry the cargoes all the way to the point of reshipment for Europe

And thus we arrive at the ingenious system of combination water and rail transportation developed by Robert B Goldschmidt of the University of Brussels, in Belgium In collaboration with another engineer by the name of Vanderhaegen, Mr Goldschmidt has succeeded in constructing a veritable train, which is as much at home in the water as it is on land, and which passes from the water stage to the railroad stage with no other change than the shifting of the gears of the power plant. The first unit serves as the tractor, while the other units are trailers.



View aboard the Goldschmidt amphibious train, showing one of the holds and the center connecting structure which carries the wheels

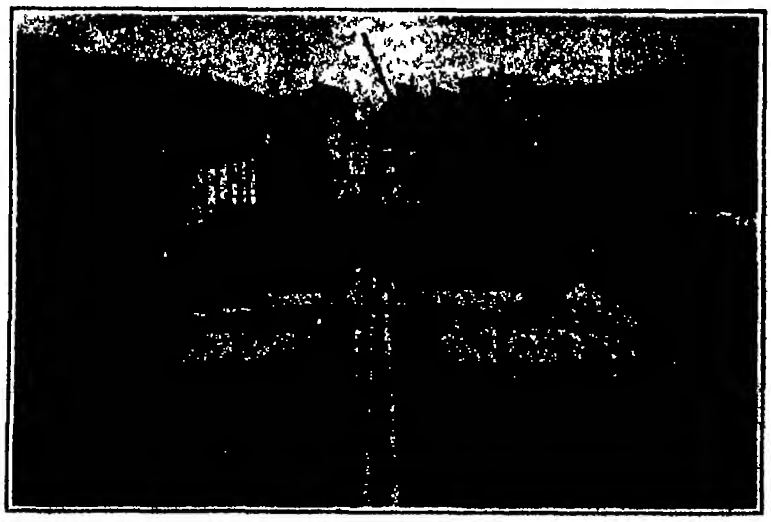
So much for the general details. Each unit of this amphibious train consists of two boats or boat-like bodies, connected together in the manner indicated in the accompanying illustrations. The four members connecting the twin boats together also carry the wheels which engage with the monorail track when the amphibious train is traveling over land Each boat is about 33 feet long and about 6 feet wide, and can carry 11 tons, while the shallow draft permits of navigation in shoal waters.

Now the tractor unit of this unusual train is equipped with a 300-horsepower plant, capable of hauling 5 to 10 trailers, with a total carrying capacity of 220 tons at a speed of 6 miles per hour

The construction of these twin boats is such that they have remarkable stability in water The unequal loading of the two boats of a given unit is said to make very little difference, indeed, one boat can be loaded to its full capacity while the other may be empty, without serious results. When the train comes to the land stage of its travel, it simply straddles the monorail that comes down into the water, and then, under its own power, climbs out of the water as dramatically shown in our cover illustration The monorail extending down into the water has a very easy grade, not more than 3 per cent, so that the amphibious train can readily negotiate it with a heavy load.

The same power plant is used for marine and land transportation The two gasoline engines, of 150 horsepower each, are readily shifted over to the four motor wheels which ride on the monorail At this phase of the journey the problem of equilibrium between the two boats of a unit assumes greater importance To the end of securing the utmost stability, the wheels have been placed well above the bottoms of the boats, as will be noted. Thus, if one boat is loaded with 10 tons and the other with 9 tons, or a difference of 1 ton, the unit will lean to the heavier side to the extent of 7 degrees from the horizontal The extreme limit of inclination is 13 degrees, at which point the boats are apt to come in contact with the rail supports, especially on curves. However, tanks are provided at the front and rear ends of each boat, in order that water ballast may be employed to balance the boats of a unit. The usual speed on rails is three miles an hour, although higher speeds can be realized with a considerable loss of stability of the train.

The construction of the monorail for the land sections of the amphibious route is simple. It is best, of course, to prepare a roadbed, so to speak, some 12 feet wide, finished off with broken rock or gravel in order to prevent the encroachment of the dense tropical vegetation. In the center of this roadbed or right-of-way are placed a long row of upright posts which support the stringer with its monorail. The construction can be carried out with heavy timber The beginning and the end of each land section, where the trains pass in and out of the water, are formed by the inclined monorail which goes down into the water. Guides are provided on either side of the monorail, so as to bring the train into the proper position for the engagement of the wheels with the monorail. The train is provided with brakes, which are used when going down an incline and into the water



Stern view of the tractor unit of the amphibious train. The rudders and the propellers are in evidence

Uncle Sam and Radio

Further Developments in the Deliberations of the National Radio Conference and Future Probabilities

By George H. Dacy

A RECONVENTION of the National Radio Conference is being held at this writing and will continue until all the matters pertaining to radio regulation are reduced to a workable and satisfactory basis. The indications are that the second official meeting of the conference representatives will not last longer than a week or ten days. The recommendations of the original meeting have been discussed extensively and argued pro and con to the point where the chaff has been eliminated and only sound, logical subject matter remains to be offered to the Congressmen who will have charge of framing a proposed new radio law which will be presented to Congress.

If the recommendations of the Conference are legalized, Secretary of Commerce Herbert Hoover will be the director of the ether so far as radio telephony is concerned. The American urchin and the amateur class which is interested keenly in wireless will be adequately protected and served. The demands of the rapidly developing radio art also will be protected in the modern regulations. The new legislation will be extremely flexible, in order, as the occasion for so doing arises, that it may be changed to accord with the rapidly developing radio industry. It is quite probable that, henceforward, the granting of radio licenses will be wholly within the discretion of Secretary Hoover, and that he will also be empowered with the right of revocation in order to eliminate unnecessary stations that are duplicating certain lines of service or in other ways unduly interfering. Potentially, the Secretary of Commerce will have ample power so that he can classify radiophone broadcasting stations, assign bands of wave lengths, and generally eliminate interference of stations of the same class of service with each other and among stations of various classes of service in so far as is possible.

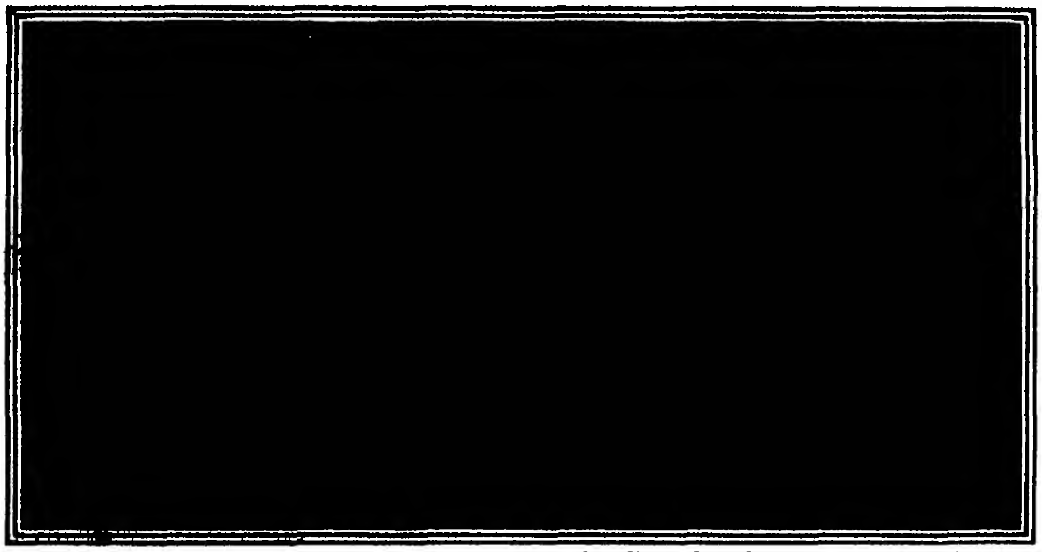
During the interim between the two main sessions of the National Radio Conference, the experts in charge of the radio work in the various Government bureaus including the Departments of Agriculture, Commerce, War, Navy, Post Office, Treasury and State have met together and formulated Government policies. Their cooperative plans and arrangements will receive special official consideration in any new radio regulations which are passed by Congress. Representative Wallace H. White, Jr., of Maine, who has charge of the preparation of the new radio regulations and who will introduce them into Congress, is opposed to any monopolistic radio service which might possibly develop in the future. Recently he said "We hope that the bill when passed will include a provision that no individual or corporation shall get the vested right in any wave length assigned to that particular class of individual or corporation."

The sentiment of the radio experts who attended Secretary Hoover's initial radio convention was that the radio laws should be amended so as to give the Secretary of Commerce adequate legal authority for the effective control of the establishment of all radio transmitting stations, except amateur, experimental and Governmental stations, and of the operation of non-Governmental radio transmitting stations. The general opinion was that radio communication is a public utility and as such should be regulated and controlled by the Federal Government in the public interest. It was also apparent that the conferees believed that the types of radio apparatus most effective in reducing interference should be made freely available to the public without restriction.

The sense of the conference was that the Secretary of Commerce should assign to each radio telephone broadcasting station a permissible power based on the normal range of the station, such as Government broadcasting stations, 600 miles; public broadcasting stations, 250 miles, private and toll broadcasting stations, 50 miles. In this connection it was recommended that the Bureau of Standards should make a scientific study of the relation between the normal reliable range of a station and the antenna power on the basis of the use of good available receiving apparatus. It is anticipated that this relation will change with the development of the radio art.

Another recommendation was that the same wave (or overlapping bands) be not assigned to stations within the following distances from one another, except that these distances may be lowered if the normal ranges of the stations are correspondingly lowered for Government broadcasting stations, 1500 miles, for public broadcasting stations, 750 miles, and for private and toll broadcasting stations, 150 miles. It was also suggested that the Bureau of Standards should make a study of the width of wave band required for satisfactory radio telephony It is generally recognized that this width depends on the methods of transmission and reception employed

As a result of the intermingling of expert radio opinions at the Washington conference, an immediate study will be made by the Department of Commerce of the best geographical distribution of broadcasting stations with a view to attaining the best service with the minimum of interference. A chart has already been prepared by the national radio experts showing an ideal distribution of broadcasting stations under various assumed conditions as to number of available wave bands and ratio of distance between stations having the same wave length to the normal range of the stations. It was also recommended that in cases where congestion of radio telephone broadcasting traffic exists, or may exist potentially, that the Secretary of Commerce assign suitable hours of operation to existing or proposed private and toll broadcasting projects.



Typical broadcasting studio, showing the microphone on the adjustable and portable stand, which serves to transmit a single voice or a chorus, a single musical instrument or an entire orchestra

The Amateur Committee of the Radio Conference suggested the following recommendations (1) That the status of the amateur be established by law, (2) That the limit of wave length band allocated to the amateur be specified in the law, (3) That the wave length band allocated to the amateur be from 150 meters to 275 meters, (4) That the Secretary of Commerce subdivide the amateur allocation into small or wave length bands for the various classes of amateur transmitting apparatus, at his discretion but in the following order of wave lengths starting at the shortest wave, spark, interrupted or modulated continuous wave telegraphy, telephony, continuous wave telegraphy, (5) That the amateur continue to be under the jurisdiction of the Department of Commerce, and (6) That for the purposes of self-policing among amateurs, Amateur Deputy Radio Inspectors be created, selected from the amateurs in each locality. The duties of such amateur inspectors will be to cooperate with the District Radio Inspector in the observance of radio communication laws and regulations of the United States and the observance of such local cooperative measures as are decided upon in each community for the minimizing of interference between the various groups of the public interested in radio These Amateur Deputy Radio Inspectors are to be vested with whatever authority may be necessary in the opinion of the District Radio Inspector

Another commendable suggestion of the conference was that the Secretary of Commerce at his discretion may prohibit at any time the use of existing radio transmitting apparatus and methods which result in unnecessary interference provided that such action should not be taken unless more satisfactory apparatus and methods are commercially available at reasonable prices and until an adequate time interval is allowed for the substitution of the more satisfactory apparatus. Subject to public interest and the reasonable requirements of each type of service the sentiments of the conference were that the order of priority of the service should be Government, public, private and toll The consensus of opinion was that the priority in the granting of a license, the assignment of waves and permissible power to a private or toll broadcasting service should depend on the amount of public interest associated with such service It was suggested that toll broadcasting service be permitted to develop naturally under close observation, with the understanding that its character, quality and value to the public should be considered in determining its privileges under future regulations Furthermore, it was recommended that direct advertising in radio broadcasting service be forbidden and that indirect advertising be limited to a statement of the call letters of the station and of the name of the concern responsible for the matter broadcasted

In instances where all the available wave bands in any geographical district are assigned, the feeling among the radio specialists was that no further licenses for radio broadcasting in that section be granted until for some reason or other some of the existing licenses are revoked The policy of the private or toll broadcasting of any but official time signals authorized and approved by the Secretary of Commerce was also deemed objectionable Another suggestion was that the license requirements for the operator of a radio telephone transmitting station include a knowledge of the International Morse Code sufficient to receive at the rate of not less than ten words a minute

Among the other outstanding recommendations made by the experts who composed the Radio Conference was the suggestion that the Bureau of Standards make a study of the technical methods for the reduction of interference, giving special attention to (1) The reduction of the rate of building up of oscillations in radiating systems, (2) The reduction of harmonics in continuous wave transmitters and of irregularities of oscillation, (3) The comparison of the variable amplitude method with the variable frequency method of continuous wave telegraphy (4) The preferable methods of telephone modulation to avoid changes in the frequency of oscillation, (5) The proper circuit arrangement of regenerative receivers to avoid radiation of energy, (6) The use of highly selective receiving apparatus, including a list of approved forms, (7) The use of receiving coil aerials instead of antennas, with special reference to high selectivity, (8) The reduction of interference with radio communication of other electrical processes, such as the operation of X-ray apparatus and electrical precipitation, and (9) The study and standardization of wave meters.

The developments of radio telephony are being carefully followed and the reader may rest assured that we shall report all happenings of importance, just as rapidly as we can get them into print The next issue will probably contain the final decisions of the National Radio Conference

The Gentle Art of Radio Broadcasting

With the Speakers and Artists Who Are Heard But Not Seen Over the Radio-phone

By Austin C. Lescarboura

"DO you prefer to stand when you speak, or do you wish to sit down? You prefer to sit Fine! Now let us get the scenery together We will use this little table with the lamp, so that you can read your notes. Now for the transmitter Is it about right at this height? Yes, that's about right. Don't forget, talk directly into that little hole, good and loud, and keep up your voice throughout the talk About three inches away from the transmitter is a good distance All set? Let's go!"

The announcer is speaking to you at the radio-phone broadcasting station. You are a speaker on this evening's program your name is among the several names featured on the printed program for the week as well as reproduced in many newspapers throughout the broadcasting area

If it is your first try at radio-phone broadcasting, you will experience all sorts of queer sensations, for this, in truth, is no ordinary task The studio in which you are to speak is small and home-like enough, and there are just a few persons present There is barely room for an excuse to be shy Yet it is the very weirdness of the whole business that makes you uneasy—the thought of speaking through a little hole in a cylinder hanging in front of you, to an audience that mounts up into the hundreds of thousands.

If you have your speech carefully written, there need be no undue stage fright. After all, it is not so awe-inspiring The first few words, addressed at the little cylinder dangling from the adjustable stand in front of you, are soon put over, and then you settle down to reading your speech with less and less thought given to the intricacies of radio, and to the other persons in the room and the huge radio audience whom you are addressing In fact, you soon become so absorbed in your speech and in pronouncing each word clearly and carefully, with a pause at irregular but well planned intervals, to lend weight and forcefulness to your message, that you are unaware of the hundreds of thousands of listeners.

RADIO today is a continuous performance. You purchase your ticket in the form of a receiving set, such as the little one shown in the accompanying illustration, and then listen in day in and day out, whenever and wherever you please, to the music of today, the classics of yesterday, the leaders of the nation, the scientists, the news of the minute, stock quotations, and so on, without further charge of any kind For such is the radio broadcasting art of today But what about the broadcasting end? Who foots the bill? Why? Who are the artists and speakers who volunteer their services? In brief, how long is this going to last? The accompanying article is the result of the various impressions gained in studying the expansive field of radio broadcasting, and in visiting several of the broadcasting stations Sufficient material has been obtained for several articles A list of radio-phone broadcasting stations appears on page 428.—THE EDITOR.

The end of the speech is soon reached, as it must when you are so absorbed in a given task The announcer who all the while was sitting in a corner of the room, notices that your speech has been drawing to a conclusion He steps over to a cabinet on which a switch is mounted and as you pronounce your last word, pulls the switch

And much to your surprise, absolutely nothing happens. Of course nothing should happen in this case, but somehow or other you are not accustomed to addressing a mute and invisible audience There is a dead silence No applause of any kind No comment

Perhaps something went wrong It is hardly believable that the speech got beyond the four walls of the room Still, the man in charge of the program thanks you and leads you out of the room, as the announcer steps up to the transmitter and states once more that "This is station XYZ. Madam Soprano of the Metropolitan Opera Company will now sing for you The first song is ——"

The next morning, coming down to the office, two friends inform you that they heard your speech Several telephone calls come in during the day informing you of the successful reception of the speech A number of letters post cards and even telegrams dribble in for the next few days, depending on the interest created by the speech For several weeks you are reminded at odd intervals of that speech which you made at XYZ, by friends relatives, acquaintances and strangers, until you wonder if people ever do much else than listen in to radio-phone broadcasting. But it got across, and that is the main thing!

Broadcasting is a new art It is little more than a year old and like any young art it is full of that rare interest which must exist in any art until it has simmered down to an established basis There are no set rules in broadcasting procedure Much of the work is still on an experimental plane Even the broadcasting stations themselves are in a transient stage and resemble nothing more than the usual motion-picture studio, in which everything is done for the gaze of the camera rather than for the comfort and convenience of the performers. Indeed, the more we learn of the gentle art of broadcasting, the more we notice a striking parallel between it and the motion picture. In their general characteristics they are much alike, these two young arts. One deals with pictures, animated pictures which tell stories, the other deals with sounds —speeches, songs, news, weather forecasts, children's bed-time stories, financial reports, business statistics, marine news, time signals, and whatnot

Having grown up over night to gigantic proportions, the broadcasting art is unwieldy in the extreme—not so much in a technical sense, because the broadcasted talks and music are quite excellent, as anyone with a receiving set will gladly affirm. From a business standpoint, however, the art is truly anomalous. Here are over one-hundred stations providing speeches, news, music and so on for hundreds of thousands of listeners, yet deriving no direct financial returns. Granted, these same broadcasting organizations are for the large part engaged in the manufacture of radio apparatus and are reaping an astounding harvest of business, the fact remains that there are many other radio manufacturers harvesting just as rich a crop without spending a single cent or devoting a single moment to the sowing of that radio crop. It is highly unfair, to be sure.

Then again, the audience, after purchasing the original receiving set, never contributes a single cent toward the maintenance of the broadcasting stations. Occasionally a vacuum tube must be purchased, as well as a "B" battery, galena crystal pair of receivers, and so on, but as likely as not this business may go to a concern not engaged in broadcasting.

Such a situation is identical to that which would exist if phonograph companies sold their machines and then supplied the records free of charge for all time. Obviously, such a business is not founded on logic. While the radio boom persists, a few companies can well afford to maintain the radio-phone broadcasting stations, but sooner or later other arrangements will have to be made Whether a charge will be necessary for broadcasting reception, or whether a charge will be made for the privilege of speaking or singing via radio, the author does not profess to know or even dare to guess. Still, the present situation is constructed on unstable lines and must sooner or later give way to something more substantial.

So we come to the question of talent—the singers and the speakers and others who entertain us night after night. To them we owe much, because so far their services have been offered without charge of any kind. Even so, the leading musicians of the world have sung and played for the radio audience, and many more are scheduled to go before the little cylinder or the "dish pan" before long.

At this stage of the art, the average radio-phone broadcasting station is an improvised affair. How could it be otherwise? It was inaugurated over night to take advantage of the technical advances in radio telephony Since then, it has never had the necessary time to spare in order to build a real broadcasting studio with every comfort for the talent and with some consideration for the visitors.

A typical radio-phone broadcasting station may be described as follows A long, narrow room, formerly used as a cloakroom for the office employes, has been appropriated for the broadcasting activities of the company At one end stands a beautiful piano of the reproducing variety, with its long bench. This piano may be played by a flesh-and-blood pianist, or by Grainger, Godowsky, Rachmaninoff or Hoffman, not in person, of course, but in the form of a perforated paper roll. Then there are several phonographs of various makes, for the broadcasting studio does not play favorites. Along one of the long sides of the room is a small table, with a silk-shaded lamp to add a touch of home atmosphere and to reassure the performers, followed by an automatic organ, several desks, and plenty of chairs. It is just a plain room, with very little embellishment except some draperies which can be placed over the bare walls whenever it is necessary to hide them with all their ugliness. In fact, most of the photographs taken in the radio-phone studio are flashed only after the draperies have been artistically arranged, while a few flowers or plants bought or borrowed from the nearby florist help matters ever so much. The last pieces of furniture—and the most important, perhaps—are the cabinet containing little lamps and plenty of switches, wiring, and so on, comprising what is called the modulating equipment, as well as the little transmitter mounted on a portable stand. The cabinet is a wooden framework covered with copper screening, not for the purpose of keeping out flies or mosquitoes, please be sure to note, but to prevent the delicate apparatus from being disturbed by electrical and magnetic influences within the room itself. For that matter, the various conductors connecting up the cabinet and the transmitter are sheathed in beautiful, bright and neat woven copper sleeves or tubes, not for the artistic but for the electrical reason mentioned.

The radio-phone transmitter proper is located in a small room near the roof of the building, and is attended by one or two operators. This is the actual radio-phone station, for it contains all the elements of transmission. When the studio is to broadcast, it is connected with the radio station upstairs by means of the switch already referred to. A system of wire telephones assures instant communication between the studio and the station.

The radio-telephone transmitter consists of a cabinet closed in by iron grill work, so as to preclude damage to the delicate vacuum tubes. Five tubes are employed for normal operation. The transmitter is at the extreme end of a long operating desk or table, on which are placed ordinary telephone instruments, radio apparatus, a receiving set with amplifiers, telephone head-sets, and a loud-speaking device. While the studio is in operation downstairs, the operators hear the speech or music by means of the loud-speaking device, actuated by the long-distance receiving set at the end of the table. The receiving set is connected to a single wire antenna, and serves principally to pick up the Arlington time signals which are amplified and then impressed on the radio telephone transmitter so as to be [illegible]

mitted to the radio-phone audience on 360 meters.

The aerial is a large affair, as all aerials for wireless telephony must be for good results. It comprises eight wires supported on wide spreaders and tall steel masts, high above the roof. Below it is another aerial, about eight feet above the roof, known as the counterpoise. This secondary aerial serves as the ground and gives better results for radio-phone transmission

Always has radio been a temperamental thing, if inanimate things can be temperamental. It has worked best when nobody was around to appreciate the fact, and worse when it has been on parade, so to speak. Today the same holds true. The radio-phone, with its delicate tubes and controls, sometimes lies down on the job at the wrong moment. And on this fact hangs many an interesting tale.

Not so many weeks ago a large band composed of the musical employes of a leading manufacturing company were featured on the evening program They came to the broadcasting studio and they played—played as they had never played before, fully realizing that they were playing for hundreds of thousands of listeners. The radio-phone devotees, scattered over a wide area, were delighted as they are always delighted when listening to a good number on the radio-phone program

Then things began to happen. First one tube, then another tube blew out, up in the radio station. These tubes, or vacuum tubes to be more specific, are made up in the company's factory in small lots, and there is seldom a real reserve supply on hand Finally, all the tubes were blown out, and the station was simply through. The announcer in the studio below was informed of the fact, but, taking account of the enthusiasm of said band which had come from some distance away to entertain the radio audience, he did not have the heart to tell the musicians what had happened Instead, he simply went right on, announcing the various selections in turn and letting the band play to their heart's content, even though the sounds never got beyond the four walls of the studio.

Then there is the other side of the same picture The radio-phone devotees were listening to the wonderful band concert when suddenly, without notice, although the band music had been getting weaker, there was a total silence. What could the trouble be? Every radio-phone receiver right then and there was overhauled by as many greatly agitated radio-phone enthusiasts, in search of trouble. And this story explains to many of them what happened on that particular evening when the radio-phone suddenly went dead.

Please remember that there is a switch in the radio-phone studio that stands between the studio and the outside world A number of stories could be told about that little switch, although just one story will suffice

Every so often an artist, a talker, or an orchestra is scheduled to appear before the radio audience, because they are willing to do so in the first place, and they have been passed upon as worthwhile entertainers by the radio-phone management. It is virtually impossible to have tryouts, as can well be appreciated because all the talent is purely voluntary and there are many drawbacks when dealing with anything that is free of charge, as you may well know from practical experience. At any rate, the performers or entertainers are passed upon solely on their past record. If they have played in public, if they hold a diploma from some school of music, if they are well known in their respective fields, if they occupy an important position—all these factors count for their face value in considering the suitability of a speaker or musician aspiring to an "appearance"—an unfortunate word, but there is no word yet coined to meet the circumstance—before the radio audience. As a matter of fact, the various radio-phone broadcasting stations, especially those in the large metropolitan districts, have more applications for space on their programs than they can possibly catch up with for a long time to come.

Anyway, the evidence in the case is not always a good guide. Every so often a small orchestra makes its initial bow before the transmitter of the studio and it does not take much more than the first few bars of music to convince the announcer and the station management that a mistake has been made. Then the little switch comes into play The announcer maneuvers about until the switch is reached, and then, without formality of any kind, the switch is pulled, disconnecting the studio from the outside world The orchestra, meantime, plays blissfully on, not aware that its audience is encompassed in the four walls of the studio Meanwhile the operators in the radio station, realizing what has taken place, take hold of the radio-phone program and bring a phonograph, kept in their room for that very purpose, into action. They continue to operate the phonograph until some happier moment, when the announcer downstairs can introduce the next number on the program

Sometimes a speaker does not confine himself to his subject, but wanders into the publicity field, soon waxing eloquently with praises of ABC automobiles or PDQ shoes or XYZ bread, and so on He can rest assured, whether he realizes it or not, that rank publicity will not be sanctioned in the usual well managed broadcasting station *There may be public radio-phone* broadcasting stations in the near future, where the publicity hunter can exercise himself to his heart's content, but for the time being he is not allowed to burden the radio-phone audience with his talks while some legitimate entertainers are crowded out

Temperament—of course there is temperament in the radio-phone studio, just as there is in the motion picture studio Often this temperament results in queer incidents A case in point runs as follows

Early in the history of radio-phone broadcasting, all stations were required to "stand by" or remain inactive for a period of three minutes, every fifteen minutes, in order to listen for distress signals from ships at sea A prima donna from some well known opera company had just rendered an aria from "Aida," if my recollection serves me correctly The announcer, going about his work in the business-like way that comes through doing the same thing day in and day out, stepped up to the small transmitter, and said: "We will now stand by for three minutes, to hear distress calls." Imagine a high-strung temperamental, famous prima donna, not previously informed of this very necessary bit of business, listening to this remark at the end of her song! What she said to the announcer cannot be printed here, but suffice it to *say that she used up all her* choice adjectives, and gasped for more

Another time a Russian singer worked himself up to a high pitch while singing a very difficult operatic air The broadcasting studio is a very small room you will remember from my previous description At any rate the singer tore off his coat, followed shortly after by his collar and tie and then his shirt singing all the while before the dish basin transmitter then in use Needless to say the announcer had to act quickly for there were ladies in the room He signaled to several of the men present to help him move some draperies in front of the rapidly disrobing Russian singer, who when he had finished his song, asked what was the idea of wrapping him up in draperies. He had not realized what he was doing so we are assured by the broadcasting station announcer

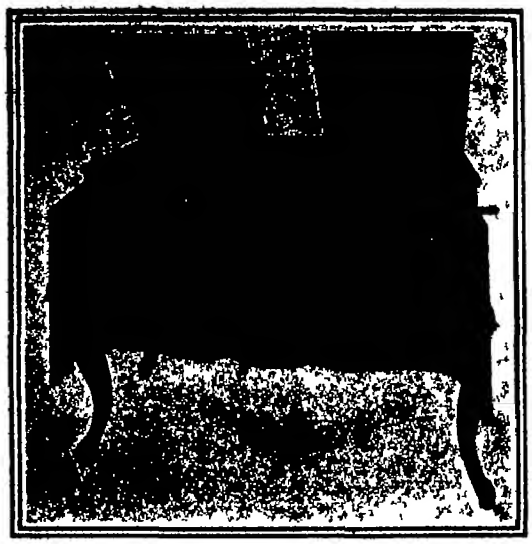
Another time two Italian singers were rendering a duet before the "phonetron," as the dish basin transmitter is called One singer was the possessor of a good, rich voice The other's voice was impossible The man with the good voice could stand it no longer, and he began nudging his partner and swearing at him in Italian This continued all through the duet, despite the admonitions of the announcer There was no little switch in those days to cut off the unruly performers from the outside world In fact such instances as this caused the switch to be introduced There followed a flood of inquiries, asking why the monologue accompanied the various selections. It was a new idea but why? asked the inquisitive radio audience

Another instance, prior to the installing of the switch, took place when another prima donna came to the studio to render a few selections This lady decided to accompany herself at the piano The announcer having become aware of the profane ways of the lady decided to take no chances. So, taking the transmitter off the stand, he climbed up on the grand piano and pointed the transmitter toward the lady All during her various selections she is reported to have cussed pretty much everything about the place and the announcer busied himself "shorting" the microphone transmitter at such moments as a volley of profanity was *directed at him.*

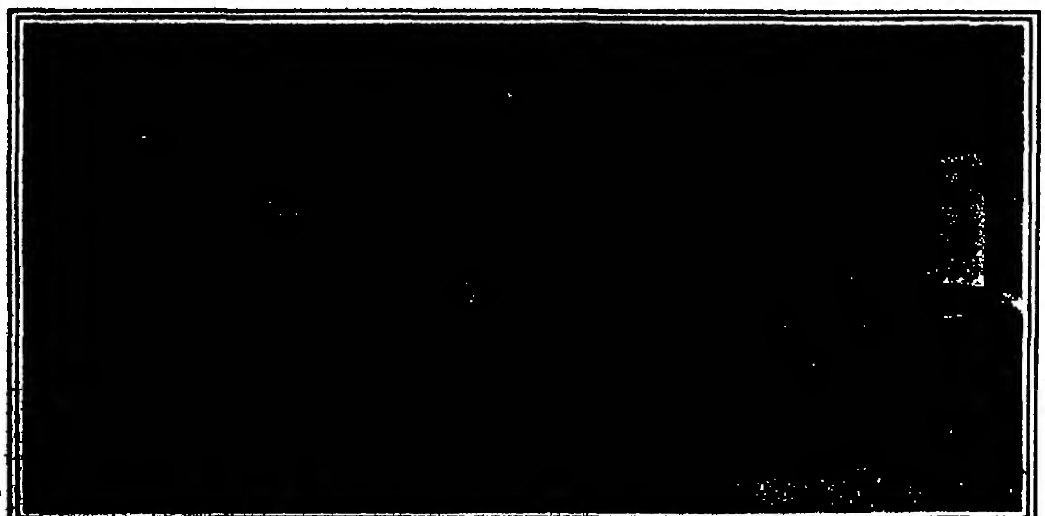
Then the performers have their pets, which must come in for some share of the evening's program One singer brought her Airedale with her A pampered dog, that Airedale, who could not understand why his mistress was talking and singing into a wash basin dangling from a portable stand The announcer made several attempts to amuse the dog fondle it and in every other way keep it quiet but to no avail Between bits of her songs the singer called to her dog, said kind words to him, and kept on talking about Larrie much to the bewilderment of the radio audience The next few days several telephone calls and letters were received, inquiring as to who "Larrie" might be Was it her manager husband or friend, who was so impatient?

The radio-phone audience watches the radio programs with keen interest Indeed, one almost begins to wonder if the radio-phone audience is paying for the service, so severe are the criticisms at times. Following an unusual amount of phonographic and automatic piano music referred to as "canned stuff" by the radio audience, there is certain to be a large volume of complaints The radio phone audience is certainly highly critical, just as it is highly appreciative when the program is good

One thing is certain and that is the permanency of radio-phone broadcasting No doubt the present arrangement is not permanent because it is not altogether a fair one But broadcasting has become so popular and its possibilities are so great that it can never become obsolete, as many would have us believe Like any new art it has its imperfections, which must be corrected and altered and refined until the art becomes stable, as it must in time.



Numerous cabinet receiving sets are now making their appearance for home use. This one is a combination radio and phonograph entertainment device, which can be operated by anyone



The radio room of a typical radio-phone broadcasting station. Note the phonograph in the background, the radio telephone transmitter, the loud-speaking device, and the long-distance receiving set, on the table

Our Point of View

Wrecking the United States Navy

THE efficiency of a navy depends upon its ships and its men, and of these the men are by far the more important The most magnificent assemblage of fighting ships conceivable, if manned by insufficient crews of poor training and low morale, could be readily overcome by a smaller and less up-to-date fleet that was fully manned by officers and men of the highest skill, and of absolutely unshakable morale The treaty did a noble work in abolishing the threat of naval war, and getting the three leading naval powers to agree to a ratio of 5—5—3, in the total displacement of their fleets. The question of the personnel was left to the decision of these several powers. Great Britain has announced that she is cutting down her personnel to 104,000 officers and men, Japan proposes to reduce her enlisted strength to 68,000, the United States Navy, in the endeavor to meet the demand *of the country for extreme economy, has asked, through* the Secretary of the Navy, for only 96,000, as the very lowest minimum with which the Navy can be maintained with any approach to efficiency

In spite of this moderation on the part of the Navy, the House Naval Committee endeavored to cut down the enlisted strength to 67 000 men, and a vigorous and strong fight was made in the House of Representatives to turn this suicidal proposition into law We do not hesitate to say—first, that the 104,000 men allotted for the British Navy is a reasonable amount, justified by long experience, secondly, that the 96,000 men asked for by our Navy Department represents a smaller force than is necessary to maintain our fleet at all times in a condition of efficiency, thirdly, that to reduce the number to 67,000 would be, in effect, to destroy absolutely the efficiency of the fleet, by causing our ships to be greatly under-manned, and thereby producing a sense of discouragement and neglect in the officers and men.

If the question be asked—Why did our Navy Department ask for only 96,000 men, when the British Admiralty in manning a fleet of the same size, determined upon 104,000 men, we reply that the 96,000 was arrived at by a board of naval officers, who were asked to determine *the absolute minimum of men that was necessary* to maintain our ships in a condition of fair war-time efficiency—"fair," mark you, not maximum efficiency In arriving at their estimate they made the following important reductions.

1. The war proved that there must be sufficient men aboard to man both anti-torpedo broadside batteries, the estimate calls for manning only one broadside on one side of the ship 2 The number of men in the ammunition handling rooms was reduced below that which is necessary for the highest speed of firing 3. The number of men for bringing the shells from the magazines to the loading trays was reduced to a point which would slow down the speed of delivery 4 The number of men in the engineers' department was cut down to a point which would make it possible to maintain full speed for no longer than two watches. 5. Target practice rules were modified so as not to require replacement ammunition, thereby cutting down the number of rounds per minute 6. The amount of target practice throughout the year was reduced and the speed of the battleships was lowered from twenty to ten knots, and of destroyers from thirty five to fifteen knots 7 The "junketing" was reduced to a minimum—that is to say, the use of the ships at National and holiday celebrations was discouraged. 8. Finally, the Board greatly reduced the requisitions for the periodical reconditioning of the ships in harbor

The strength of 96,000 men, as requested by Secretary Denby was no mere guess, but was decided upon in an honest endeavor to meet the demand for economy up to a point, beyond which the effectiveness of the Navy would be most seriously imperilled Hence, we do not hesitate to pronounce the recent attempt to cut our personnel down to 67,000 men as being nothing more or less than a movement, conscious or unconscious as the case may be, to *wreck the Navy* In a spirit of compromise, the President asked for 86,000 men, and this the House has granted It is not enough. The Senate should stand out for the 96,000 men, which the seagoing officers of the Navy have found to be the absolute minimum compatible with the efficiency of the fleet.

To Save an Infant Industry

THE war served to develop several new industries in the United States, notable among which were the manufacture of optical glass and instruments of precision and the production of potash for fertilizers. Although the armistice found such industries in good working order, they were not sufficiently established to be able to hold their own against foreign competition, and the Government was asked to protect them to an extent that would prevent their being swamped by foreign importations, and to continue this *protection until they were strong enough to stand upon* their own feet and meet outside competition successfully When the question of assisting the optical glass manufacturers was before Congress, we urged that Government help should be granted, and we consider that the arguments which were valid then are equally valid today

Potash is the most important ingredient of agricultural fertilizers, and normally the United States consumes 250,000 tons of it per year Before the war this country produced practically no potash salts, and our importation from Germany was 270,720 tons. When the war cut us off from Germany, the Government sent out everywhere an urgent request that everything possible should be done to discover deposits, and push forward the production of potash Natural deposits were found in the brines of Utah, Nebraska, and California, and costly plants were built to recover potassium from these salts, and also from the dust of cement kilns and blast furnaces, from the waste liquors from distilleries and from beet-sugar factories, from the greensand of New Jersey, and from many other sources. The result was that by 1918 one hundred and twenty-three different plants were producing annually some 54,000 tons of potash Naturally, in new industries involving the lavish expenditure of capital and operated under costly war conditions, the price of the product was high, but the coming of peace, and the experience which was being gained, both in the laboratory and in the factories themselves, was gradually reducing the price, and gave promise that, ultimately, it would be brought down to a figure which would render possible successful competition with the great German potash trust. The German potash is mined, much after the fashion of coal, from 204 mines, of which 17 are in Alsace and now belong to France. These mines formerly constituted a monopoly backed by the German Government. They have a selling corporation known as the Kalisyndikat After the war a representative of this corporation made a contract with 34 American fertilizing manufacturers to purchase 75 per cent of their requirements from the German Syndicate, and a fixed tonnage from the French Alsatian Syndicate, at one and the same price

Now the response of the citizens of the United States to the call of the Government resulted in the erection of over one hundred potash plants, at a cost of over \$40,000,000, and the effect of the post-war re-invasion of the United States by the German potash monopoly has been to close down every one of these plants, which at the present stage of their development are absolutely unable to meet the low price, due to the abnormal exchange, at which German potash is being offered in our American market.

In their extremity potash manufacturers are asking Congress to extend a gradually diminishing amount of support to their industry, extending over a period of five years. This protection would consist for the first two years of a duty of 2½ cents per pound, 2 cents per pound for the third year, 1½ cents for the fourth, and 1 cent for the fifth year The manufacturers are satisfied the improvements which they have made and will continue to make in their processes will enable them at the close of this period to stand upon their own feet. Our present production is about 54,600 tons; but so enormous are the natural deposits in California and elsewhere, that if we can but save the infant industry, its growth will be so large that we shall be in a position not only completely to satisfy our own demand, but to enter successfully the markets of the world.

Highways and Politics

WHEN a great engineering undertaking is being put through under government auspices, the necessity of separating the political and the engineering sides is ordinarily recognized by the most dyed-in-the-wool politician. The engineer may be interfered with, grafted upon, forced to play politics, but the most uninformed ward-boss will understand that after all, an Ashokan Dam, a San Francisco Bay Bridge or a Panama Canal requires continuity of engineering policy and engineering control.

In the small-time engineering work done for local or state governments it is otherwise. An engine can quite well be ordered from a catalog by a Republican, installed by a Socialist, and put into operation by a Democrat elected on a fusion ticket A street-grading project does not suffer if modified and carried out by another administration. It is unfortunate that the professional man must become the shuttlecock of politicians, but when he engages in this class of work he does so with his eyes open, with full knowledge that politics will determine his tenure.

The engineering of our state highway systems is usually treated as just such a job of routine, which can be batted about from one administration to another without prejudice In 34 states, whose highway commissions have had an aggregate life of 296 years, there have been, by actual count, 127 changes of executive—an average for each department of one new head every 28 months. Whether the chief officer be State Engineer and Surveyor or Highway Engineer or Superintendent of Roads or Chief of Public Works or Commissioner of Highways, whether he be elected with the rest of the state ticket and hence automatically changed when the administration changes or whether he be appointed by the incoming Governor as a reward for deserving Democracy or rock-ribbed Republicanism, it is the universal American practice to regard his job as an adjunct to the regime in power and a part of the spoils of war

But the bald fact is that under present conditions highway engineering is just as much in need of a continuity of policy and a long tenure of office as is the construction of a single specific work of magnitude like a big bridge or a dam Roads must be built that will outlast the bonds that pay for them, that may be kept in good shape at proper cost, that shall serve the adjacent territory and the distant, that shall link up with one another properly, that shall accommodate the traffic of today and be capable of accommodation to that of tomorrow, that shall be safe where they meet, where they cross streams and railroads, where they wind, where they climb. A new commissioner is not chosen for his prior fitness; he must make himself fit after he gets in. He cannot visualize all these needs, or learn how he may plan to meet them, until he has been in office for two years at least. But he is then ripe for eviction in favor of an inexpert successor who must begin all over again.

Our state highway commissions are today a training school for highway engineers—and a source of tribulation to those that are trained. Every policy and every procedure that experience has shown to be good must be sold afresh to each new highway executive, and always the sale is complicated by the fact that the hostile outgoing faction had taken up with the idea, which is therefore probably crooked and certainly an object of deep suspicion.

Our Point of View

With the Federal aid now under way, we shall spend something like $700,000,000 per year on what is intended to be a permanent national system of highways. Federal supervision to some extent goes with Federal aid—but this is not enough. Any private enterprise on which one tenth this sum was to be expended would be started by getting together the most competent engineering staff obtainable, and the members of this staff would know that their jobs were as permanent as their ability to handle them. Would it not be well to carry the same idea of a continuous executive policy into the greatest constructive public undertaking ever launched?

Let's all get together and take our highways out of politics!

Giant Trees in the Olden Days

IF these lines should meet the eye of the owner of an automobile, who happens also, to be a tree lover, we suggest to him that he take a run out to the little village of Basking Ridge, N J As he tops the hill he will come rather suddenly upon a fine old church, set in a typical graveyard of revolutionary days, where in rather close contiguity both to the highway and the church, he will see an oak tree of surpassing size and of striking symmetry in its branching and general contour The villagers will tell him that General Washington, with a section of his army, halted one extremely hot summer day at Basking Ridge, and that he and his staff grouped themselves for lunch around the trunk of the tree, which even in his day was noted for its unusual size The story may well be true, for this specimen, recently measured by the writer with a steel tape, was found to have a girth of 17 feet 6 inches, and further taping showed that the extreme spread of its branches, out to out, was 120 feet There were giants on the earth in those days, and there is every reason to believe that this splendid fellow is merely a survivor among many such trees that had grown unmolested, century after century, in the quiet of the primeval forests.

The other day we came across a description of the recent repairs of the great oaken roof of Westminster Hall, London. The roof is a typical medieval structure, and is remarkable for its great span of 70 feet It was found that some of the timbers were of such great diameter, and maintained their dimensions through so great a length, that the English forests of medieval times must have abounded with trees that were even larger than this solitary survivor among the Jersey hills. Westminster Hall was roofed in 1809 In the intervening centuries the death watch beetle has excavated hollows in the great timbers in which, says the *Builder*, a "full-grown man could lie completely hidden." Only heart oak was used, and since the hammer posts measure 2' 5" in thickness and 22 feet in length, the trees from which they were cut must have been some five feet thick at the butt and over three feet at 20 feet above the butt. Again, the collar beams, 2 feet in depth, are 40 feet long. The trees from which they were cut must have been 3 feet in diameter 20 feet from the butt and 2 feet diameter 40 feet up. There must have been many such giant oaks. Only in rare cases, as at Basking Ridge, do we see a solitary reminder that the lofty trees of Yosemite formerly found their counterpart in the hardwood forests of Eastern America and the Old World.

The Patent Situation as Viewed by a Federal Judge

RECENTLY in Washington, the American Patent Law Association gave a banquet in honor of Chief Justice Taft and, except for the Chief Justice, the principal address of the evening was delivered by Judge Julius M Mayer of the United States Circuit Court of Appeals. Judge Mayer has presided over many important patent trials, notably the vacuum-cleaner and the wireless cases, and what he says about patents and patent litigation is of especial interest. We quote portions of his remarks.

"No man can do a particular class of work at his best unless he learns to love that work. Imagination and sentiment beget enthusiasm and enthusiasm helps lighten any labor Unusual as it may sound, a patent case may often be fascinating Within the four corners of a record may be a story of a struggle against odds which rivals many a romantic tale Within that same record may be the history of a minor art or of a great art and the picture of slow steps or sudden leaps in contributions to the world's progress. The inventor in the minor art may have made within its narrow limits a contribution relatively as valuable as the ingenious or far-sighted scientist may have made in a greater art

"A busy court thus comes in contact with commercial and scientific progress from every angle and from every side Within the limits of his own court room he learns what is being done in the world, here and abroad, in respect of every activity in which the human mind is engaged

"If he boards a steamer for an ocean voyage, he carries a patented wardrobe trunk, he finds a patented electric light in his stateroom, he notes for his mental comfort that there is a radio apparatus, which he knows is patented in all or some of its features. As he sits down to his meal, he remembers that his potatoes have been peeled by a patented potato peeler and his lemon meringue prepared by a patented mixing machine If he prefers a land trip to a sea voyage, he remembers that there is a patented lighting system on the train, that there are patented airbrakes and an infinity of other patented devices for his safety and comfort. If he goes no further than to take a ride on one of the transit lines in his own city, he need but glance at the advertisement above him, to recognize displayed in one color or another, with attractive catchwords, certain familiar friends, from the vacuum cleaner to the washing machine, the fate of many of whom he has adjudicated

"It is then a privilege and not a burden to have the opportunity to study and to pass on these steps of human ingenuity which are a part and parcel of modern civilization In this study the judge is fortunately helped by a well equipped bar No branch of any profession calls for more thorough study and research, or for a greater faculty for simple and clear exposition No man can be successful at the patent bar unless he brings to it endless industry and high ability in explaining and clarifying the subject matter of the controversy in such manner that the lay mind, in other words the judge, may grasp the essentials, understand the technique and not be confused or misled by irrelevant or unimportant details.

"When men are dealing with a branch of law which so intimately touches the safety, the comfort and the happiness of the people, they must be constantly alert for improvements in the administration of the law The first step, of course, is in the Patent Office and it has often amazed me that so many able and faithful employes, greatly underpaid, have remained in the service. My knowledge of the actual workings of the Patent Office is too barren of practical experience for me to give any practical suggestions. I can only speak in general terms. My feeling has been that the presumption of validity should be stronger than it is, but that presumption can only be made stronger when the equipment of the office is such that the prior art can be completely ransacked and that service in the office may be sufficiently attractive to hold, in this branch of the Government, competent and fully equipped experts. If, when the case comes to court, it appears that there were several references of importance passing from the file wrapper, the presumption of validity amounts to merely a phrase, and thus it is that the courts with reluctance declare void a patent, which may have represented long and expensive effort on the part of the applicant Beyond the decree which destroys the patent is doubtless many a heart burning because of money lost and ambition thwarted In the long run it may well be that the greatest economy will be exercised by the Government in building up and retaining a staff of experts of the highest efficiency Obviously such a staff cannot be obtained or retained without compensation sufficient at least, to enable such men to live in modest comfort and make some provision for those dependent on them"

In Justice to Australia

WE have received a letter from far-off Australia, written on the stationery of the Forest Commission of Victoria by an American citizen who is a dry kiln expert in the United States Forest Service, calling our attention to the extent and importance of the Australian Railway system Our correspondent was disturbed, and very properly so, to note that in an article published in our December issue on the railway systems of the world, that of Australia was omitted He tells us that he went to the trouble of obtaining authentic information from the head of the railway commission in Melbourne and that he submits it with the hope that we will present it for our readers' attention We gladly do so—first, because the data is the latest obtainable covering the year ended June 30, 1921, and also because it enables us to complete our survey of the leading railroads and make good an omission which we greatly regretted at the time it was made, and which was forced upon us by the fact that we were unable to obtain this data at the time the article was written Our comparison was based upon statistics drawn from several sources, and chiefly from the Bureau of Railway Economics, and the Bureau of Railway News and Statistics, which furnished us with the latest official information received in this country

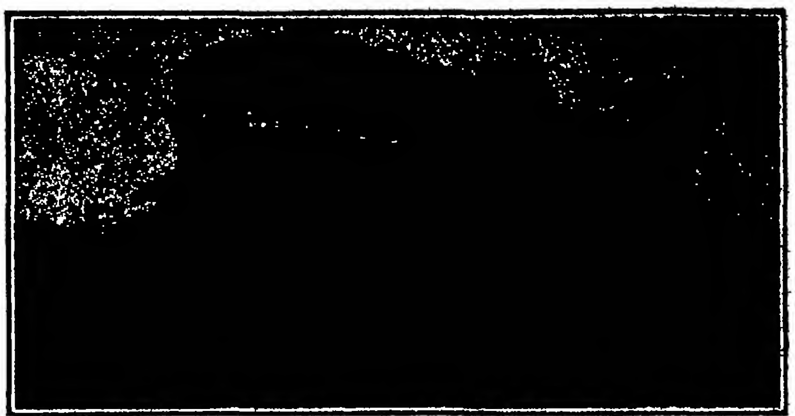
Australia as we all know, is a country of vast distances, and its further development is largely a question of the development of its railway system Speaking generally, its natural wealth lies in a broad belt of land reaching from the sea coast to varying distances inland. Here lie the gold fields which have yielded such a huge quota to the world's total supplies of this metal, and here also are to be found the grazing lands whose sheep farms have made of Australia one of the great sources of the world's wool supply Considering the population of Australia, that country has shown an activity in the construction of its railroads which testifies to the energy and far-sightedness of its citizens. Doubtless it will be a surprise to many of our readers to learn from our correspondent that a single suburban railway station in Melbourne, Victoria handles as many passengers as any other single station of the world and that he has reason to believe that at the present time there are 1500 trains, and, at least 200 000 passengers that arrive or depart each working day of the year A general survey of the various systems as furnished by the Australian Government shows that in all Australia the total number of railroad employes is 109,768 that there are 6044 passenger cars which carried last year a total of 313,570,440 passengers, and that the number of freight cars is 70,322 The total capital invested is £244,025,456 and the total amount of track is 23,263 miles.

Our correspondent writes that in his opinion, Australia is too little known to America and that being a United States citizen, and sojourning for a while in Australia, he wished to see that country accorded fair play in our own magazines and scientific journals. We are inclined to think that the degree of knowledge of Australia possessed in the United States, is greater than our correspondent supposes. Regarding American interest in that great country, it is sufficient to say that the great record which its citizen soldiers made for themselves on the fields of France has left a permanent impression of the sterling qualities of the Australian people

Railway Motor Car of Special Design

FREQUENTLY we have illustrated in these pages gas-driven railway cars designed for branch lines whose traffic was too light for profitable operation by steam locomotives. These have met with more or less success. Of late years much attention has been directed to the problem of using the regular automobile truck for railway service and we present with this article a photograph of a railway motor car, designed by H P Edwards, which was developed in South Carolina, and has been giving very satisfactory results, particularly in regard to reliability and economy in service

Special interest attaches to this car, due to the fact that it was developed by steam railroad men, and the novelties, as compared with other rail motor trucks, are due to certain requirements, well known to practical railway operators, which, it was realized, must be met, if the equipment of the highway motor car was to be satisfactorily applied on steam railroad lines. That they have succeeded is shown by the fact that one of these cars, placed in service on the Atlantic and Western Railroad, ran 120 000 miles for an entire labor and material cost of $1 608 40, at an average maintenance cost of 1 34 cents per mile.



New type of motor car for use on steam railroads. The total cost of operation for 43,800 miles was 8.18 cents per car mile

Early in the investigation it was found that you can not get good results if you merely put a railroad car body, and a set of flanged wheels, on a motor truck—for that does not make a serviceable steam railway car Standard construction that is well adapted for the highway was found not to be adapted for railway service We are informed by the builders that one unlooked for result was that the standard motor car construction will not stand up to the service requirements. It was found, for instance, that a single pair of rear wheels do not provide sufficient traction, for in a snowstorm, or with ice on the rails the converted truck proved to be helpless.

The car as developed in the railway shops and shown in our illustration is carried on two four wheeled trucks, of which the front truck underneath the engine is of the swiveling type The rear truck is fixed, and both pairs of wheels are available for traction The car is driven by a four-cylinder engine, with cylinders 4½ inches in diameter by 6½ inches stroke, capable of developing 50 horsepower Its weight is 12 000 pounds. The car has a seating capacity of 50 passengers, and a baggage space of 70 square feet. The engine propeller shaft and the transmission are of the standard motor truck type, and the differential and drive shaft are located in front of the rear truck, with chain and sprocket drive to the front axle of the truck and a third chain which is inclosed, for driving the rear axle of the truck The clutches are arranged to give four speeds forward and reverse The car can be geared for speeds up to 45 miles an hour and on excessive grades, such as those of 4 per cent as high as 30 miles an hour

Chassis of the railroad gas-driven car illustrated above, showing arrangement of engine, transmission and chain drive

The figures showing the comparative economy of steam and motor service, under the same conditions, are of great interest The car took the place of a regular railway service which consisted of two round trips daily over a 25-mile run, at a total cost of operation for 12 months of $15,405.90, or 48 08 cents per train mile In this cost estimate were included train crew wages, fuel, locomotive and car maintenance oil, waste, etc, and depreciation of engine and car was estimated at 4 cents per mile

The motor car costs under the same conditions for one year, were $3,580 48, the total distance run was 43,800 miles and the cost per car mile worked out, 8.18 cents including wages fuel oil maintenance and an estimated depreciation of 2½ cents per mile This estimated depreciation was based on the above-mentioned fact that one of the cars ran 120,000 miles at an average maintenance cost of 1.34 cents per mile, and that since the car was in such condition that it was estimated to have an additional life of [illegible] miles, the depreciation charge was put down at 2½ cents per mile.

This service was instituted to meet the competition of bus lines and jitneys. As soon as a frequent and dependable rail service by motor car was introduced, the above-mentioned competition ceased to be of importance, and passenger revenue showed a proportionate increase.

Unusual Foundation Test at Chicago

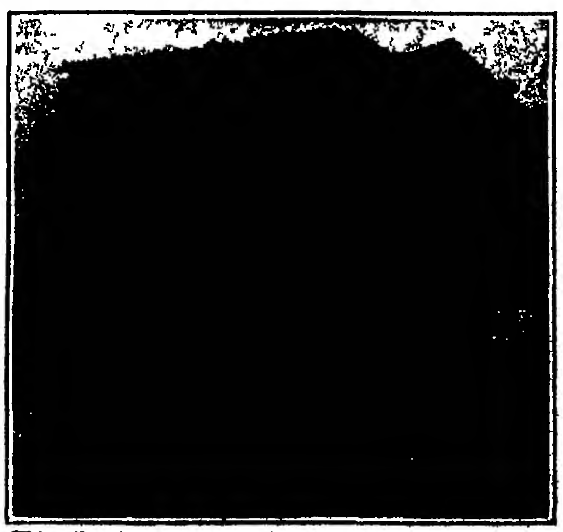
THE question of the cost of erecting tall buildings is influenced to no little degree by the character of the ground upon which they are built. If the geological formation is such that good rock is found near the surface, the cost of the foundations is very materially lower than it is in locations where the solid rock, or hardpan, is overlaid by material of a loose and yielding character. The worst case is that in which the overlaying strata of poor bearing quality is so deep that the foundations have to be laid upon undesirable material and special precautions have to be taken that the footings of the columns are of sufficient area, and the material upon which they are laid is so securely held in place, that no movement of its mass can take place.

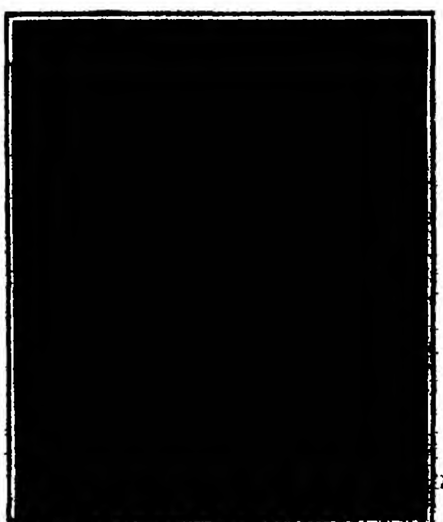
Chicago is unfortunately placed for foundation work, and before the problem had been thoroughly understood and mastered some important buildings had been put up, which subsequently, due to foundation settlement, were badly cracked and called for heavy expenditures to prevent any further extension of the damage. As a result of such experience, future footings were enlarged by the use of deep and broad foundations of steel I-beams embedded in concrete, the mass being stepped out from the footing of the steel column until a sufficient area was provided to give a safe and stable foundation.

One of the largest and most important buildings in Chicago will be the new Union Station, the engineers of which have made some exhaustive experiments on a large scale to determine the maximum safe load per square foot that can be imposed on the underlying hardpan at the site, which is found at a depth of a little over 70 feet below the surface. By the city ordinance the maximum allowable load on hardpan is six tons per square foot The engineers and architects of the Union Station believe that this load can be doubled with perfect safety on the foundation piers of their new structure.

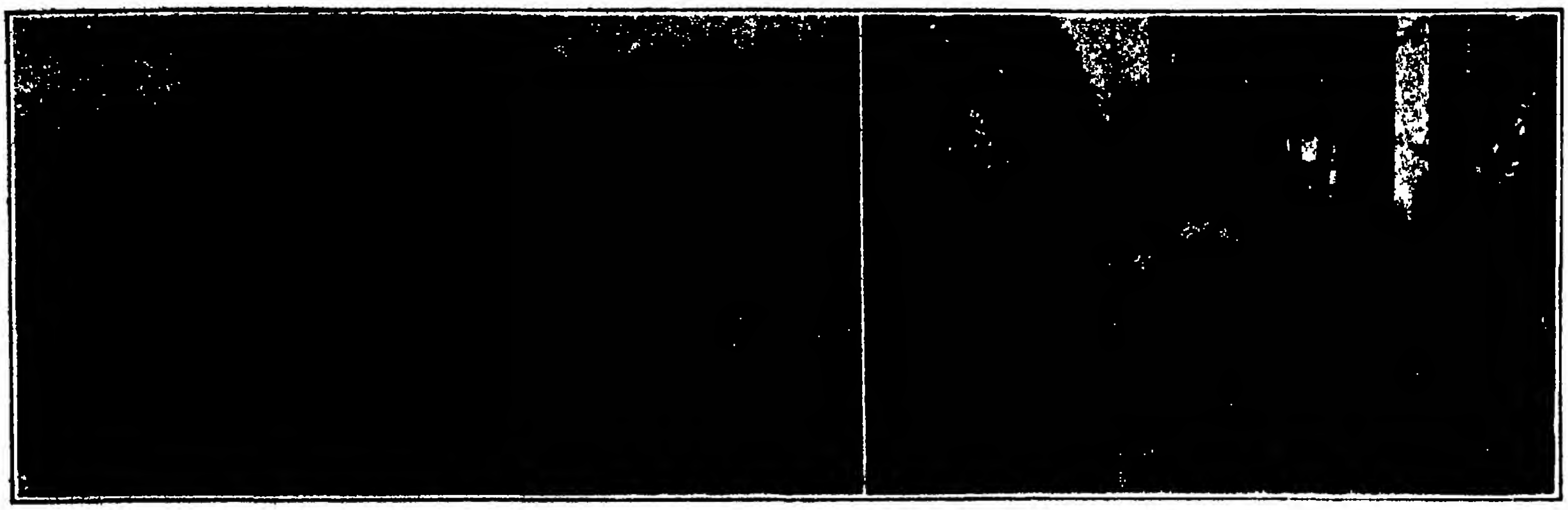
It was to settle this question that the important tests which are herewith illustrated were carried out. The engineers decided to impose on the test pier three times the allowable load which the city permits to be imposed upon foundations. To do this they built up a great pile of the heaviest steel rails, weighing 130 pounds to the yard. The total weight of this mass was between 90 and 100 tons. The rails were laid upon a grillage of heavy timbers, one on each side of a test pier, which had been carried 70 feet down to hardpan. For the purpose of putting the desired load upon the pier, a large hydraulic jack of 1000 tons lifting capacity was built and placed between the top of the pier and the load of rails above. One of our illustrations gives a close-up view of this jack. Its height over all is three feet one inch, and the diameter of the steel lifting ram is 21 inches. To get the desired effect it was necessary to raise the pressure of the hydraulic oil with which the cylinder was filled to the high figure of 6000 pounds per square inch. This is done by means of a hydraulic pump, from which the oil is led to the base of the cylinder by means of a thick half-inch pipe. The enormous pressure is delivered from the base of the cylinder to a heavy steel casting resting on the top of the pier.

The result of these investigations has shown conclusively that where the Union Station is located a load of 12 tons to the square foot can be employed, leaving an ample margin of safety.





This pile of rails was used as an abutment for the 1000-ton hydraulic jack shown on the right. The jack rests on top of a test pier, which extends 70 feet down to hardpan. By these means the engineers of the new Union Station proved that a load of 12 tons per foot may be used with safety



Left Fence parted and moved eight feet without being broken or thrown down by the creep of the earth's crust in California. *Right* An ancient ridge left by an earth movement of the past in the Mojave Desert region

Some of the works of the earthquakes by means of which it is proposed to learn their schedule

Forecasting Earthquakes

How It Is Hoped to Make the Destructive Quake as Amenable to Prediction as the Daily Weather

By H D Benton

ANNOUNCEMENT that it soon will be possible to forecast earthquakes with the same regularity and accuracy as storms, is made from the University of California, at Berkeley, where the discovery was made by Dr Andrew C Lawson, professor of geology, co-operating with astronomers and meteorologists in various parts of the world.

It is hoped that when the system of forecasting seismic disturbances has been put on an accurate basis, it will result in the saving of many lives by the foretelling of the more serious or "heaviest" quakes, and in the preservation of movable property, as well as prevention of ensuing fires.

The discovery, which consists in making the earthquake itself warn the world of its coming, follows two or three other discoveries regarding earth movements, and is based on the results of long and close study of the vagaries of strain creep on the crust of the world. The most important of these basic discoveries is that the movements of the earth's surface technically known as "creep of the earth's crust," are antecedents to as well as consequences of earthquakes. That is, the crust of the globe on which we live, to a depth varying from a few feet to scores of miles, is constantly on the move, in a generally northward direction, though, during and immediately following earthquakes, such a movement may be in two or more directions, usually in a different direction on each side of the rift or fault, where the earth's crust breaks under the strain, causing the earthquake.

The "creep" of the earth's crust, to explain it briefly and in non-technical language, is due indirectly to the fact that the poles of the earth do not run true. That is to say, the North Pole, for example, describes a circle of about 60 feet every time the earth revolves on its axis. It is as if the earth were a globe revolving on a shaft which was not true in its bearings. While this deviation of the 60-foot circle is so small, in view of the size of the earth, as to be almost infinitesimal, it is sufficient to set the soil and the rocks, even the mountains and the valleys, in a slow but steady motion, usually to the northward.

Like a liquid tide setting ever in one direction, this current of earth creates a tremendous strain in its own mass. This pull is so great that a distinctly measurable tension ensues in all the layer of earth-crust which is "creeping." When this tension reaches a certain point, something has to give way. The result is a tearing open of the earth's crust, and a backward or a sideways motion—which Dr Lawson calls "the elastic rebound"—and the visible, tangible phenomenon known as an earthquake occurs As soon as Dr Lawson had definitely established the "creep" of the earth's surface, and its rebound under the strain of its own tremendous weight, the mind of the trained investigator asserted itself, and he said

"If we find the rate of creep and the length of time of creep necessary to produce the limit of tension in the earth's crust, we shall know when and where there is to be the next earthquake, merely by watching closely the increase in tension"

It is necessary, however, that constant, consistent, accurate observations of the rate of the "creep" of the earth's crust be made at frequent intervals. With the known factors of the time and rate of creep necessary to create the limit of tension in the earth's crust the observer, whether he be in the heart of Africa, on the summit of Mt Hamilton, or below sea level in the Valley of the Dead Sea, knows all the time whether or not there is to be an earthquake in his section of the world, and, by the rate of creep, within a few hours of the time the "elastic rebound" will take place "This gives to the forecasting of earthquakes," says the University of California, in its bulletin announcing Dr Lawson's double discovery, "the same precision as that with which weather forecasts are made"

During past seismic disturbances entire mountains have been moved as much as five or six feet, other areas have been moved even further buildings, fences monuments, trees and similar ordinary fixed objects having been carried ten or twelve feet, without being damaged, by a movement of the entire crust of the earth for a considerable distance around the object moved *The segment of the earth's crust which moved* prior to the Pacific Coast earthquake of April, 1906, is estimated to have been approximately 15 000 square miles in area, and about 65 miles in depth—that is to say, 975,000 cubic miles of earth shifted distances varying from one foot to ten or twelve feet depending on its distance from the main center of disturbance the so-called "San Andreas Fault," running roughly, southeast to northwest and disappearing in the Pacific Ocean

With these conditions it is obvious that the only manner in which the position of any point on the earth's surface can be fixed is by accurate astronomical observation at regular intervals Even by this method a certain amount of error creeps in but much of this error will be eliminated by the use of the Ross photographic latitude telescope, which surpasses the international latitude instrument (visual) in accuracy as regards accidental errors. It records on the photographic plate, automatically, and so removes the human element in recording its own observations. The Ross instrument has the further immense advantage of eliminating essentially the whole of the troublesome systematic errors to which visual instruments have been and still are liable

Some of the figures obtained by Dr Lawson in his investigations of the "creep" of the earth's crust are of surprising interest as denoting the movements which supposedly immovable mountains and hills have made prior to, during and after earthquakes. From 1854 to 1906, for example Mt Tamalpais, a peak rather more than 2000 feet in height on the Marin Peninsula, north of the Golden Gate entrance to San Francisco Bay, moved 3 04 meters, in a north northwesterly direction through the action of strain creep In 1906 it moved 1 97 meters back, by elastic rebound in a south southeasterly direction not along the line of the previous movement

Chaparral, Cal moved 2 61 meters, almost due north, by strain creep from 1856 to 1906, and in a few seconds in 1906 moved backward, in a southeasterly direction 2 06 meters, almost as much as it had moved in 50 years, by elastic rebound Farallon Lighthouse, located on an island off the Golden Gate moved 2 06 meters, in a northwesterly direction by strain creep, in the 46 years between 1860 and 1906, and in the short duration of the earthquake of 1906, moved

A good example of earth flow. The soft earth formerly filling the cavity in the center of the view could not sustain the tension of the "strain creep" and flowed like a river into the valley below

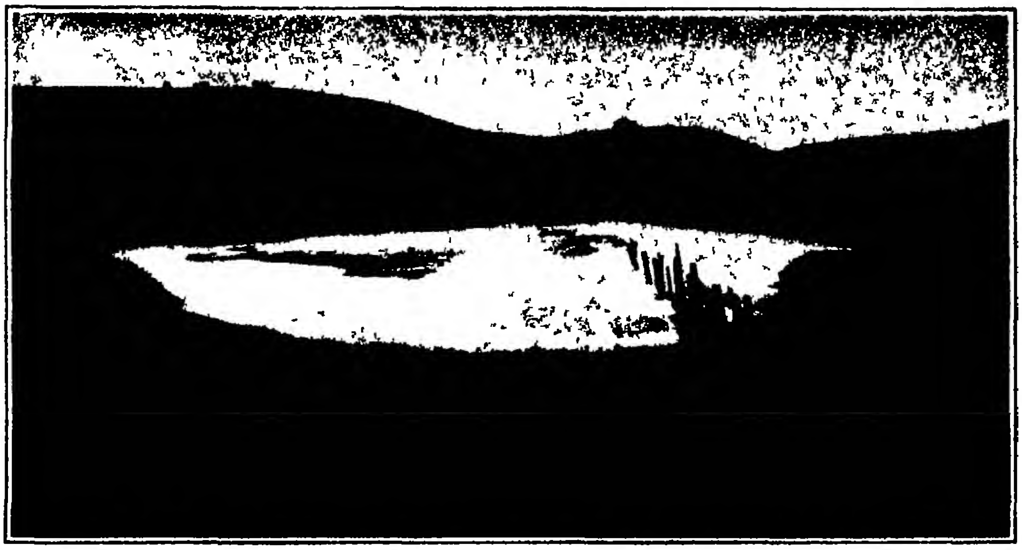
by rebound, 1.29 meters, almost due west. Other places and groups of places moved similarly, but in varying directions. Yet out of all these movements, closely recorded, studied, compared and tabulated, order can be worked and the rate of creep, as well as of rebound ascertained. Differences of soil characteristics, and of subsoil structure have to be taken into consideration, since some forms of soil and rock will endure more strain than others before the tension reaches the breaking point. Another interesting feature of these studies is that no general change of elevation of any of the points has been found of sufficient magnitude to be detected with certainty.

The practical study of the possible movements of the crust of the earth, due to strain creep, is now going on by means of monuments established at Olema, Marin county and Crystal Springs Lake San Mateo county, California. These points are about 40 miles apart on the rift. Each set of "points" consists of four concrete piers, two on each side of the fault trace of the 1906 seismic disturbance. These piers are sunk about six feet, and founded on the rock "backbone" of the country. The piers rise two or three feet above the surface, those at Olema being 13 inches square, and those at Crystal Springs 18 inches square. A bronze plate is set firmly on the top of each pier, with appliances for holding the instruments always in identically the same position with respect to the pier itself. The instrument consists of a Fauth 10-inch altazimuth, spindles and sockets for accurate observations, the whole locked in a cap fastened to the pier, the keys for which are in the possession of the department of geology of the University of California, which is conducting the observations.

From the observations so far recorded, in addition to the data already described, it has been learned that the *speed of the earth waves generated at the fault during* an earthquake is from two to three kilometers per second. Two kilometers is approximately one and one-quarter miles, and three kilometers about one and seven-eighths miles. These earth waves pass through the earth's crust too rapidly to be observed though they may and frequently do, hurl to the ground persons and animals. These extremely fast waves, however, generate other and slower waves, which are visible to the eye, and thus are recorded frequently by observers of earthquake phenomena who are not equipped with instruments for their detection.

It also has been ascertained that the length width or depth of fissures in the earth's surface, caused by earthquakes, are not true indicators of the intensity of the seismic disturbance, since different formations of the earth's crust react differently to the forces applied by earthquakes. The old and well-beloved story of the stopping of clocks also is an uncertain indicator, either of the time, or the duration, or the intensity of the shock. From hundreds of reports it has been well established that the first indication of an earthquake apprehended by man is the putting into motion of a liquid at rest. This usually is noticed before the physiological sensing of the actual quake by man.

Now however, through the work of the observers at the international lati-stations all around the world, of the men of the United States Coast and Geodetic Survey, and of the members of the geological and astronomical departments of the University of California the world will know without waiting for these physical phenomena, just when and where the earth will wrinkle its face to such an extent that it has to yawn—in the shape of an earthquake.



Lake, without an outlet, formed in the California hills by subsidence of land near an earthquake fault. The water is not from rain, but was forced up from below by the pressure that created the bowl

Testing Scales

TECHNOLOGIC Paper of the Bureau of Standards, No. 199, "Method for Precision Test of Large Capacity Scales," outlines a scientific and systematic method used by the Bureau of Standards for testing railroad master and grain hopper scales. A pointer and scale are arranged for reading the position of the beam, and the errors of the scale are determined from observations made upon the freely swinging beam. The procedure of the test is explained with the aid of a record form and computation sheet which was developed in connection with the successful application of the method in the field. In the interest of a uniform and efficient method the scheme outlined is recommended for adoption by those who have occasion to carry out tests on large scales where accuracy of a high order is required. This publication is now ready for distribution, and any *one interested may obtain a copy by addressing a request* to this Bureau until the free stock is exhausted.

Fast Cotton Dyeing

DUE to the discoveries of Mr. John Macadam, a Scotch chemist who has been in America for nearly 30 years, scientists and dye experts believe the age-old search for actually fast colors as applied to cotton goods is at an end.

It is generally known that wool has the greatest attraction for coloring matter and is, therefore, more readily permanently dyed. Silk is intermediate and cotton has the least affinity for dyestuffs and is, therefore, the most difficult to dye with fast colors. Moreover, cotton behaves differently in dyeing toward various coloring matters. It attracts some dyes, while it is incapable of being colored by other dyestuffs which readily color both wool and silk. One method of dyeing cotton goods is by steeping them in a hot solution of the coloring matter, which is done by using what is known as the simple, direct, aniline dyes.

Other dyes, such as those known as the basic colors, for which cotton has practically little or no attraction must be deposited in the form of a lake after the goods have first been impregnated or prepared with a metallic salt or some other agent. This agent is capable of combining with the coloring matter and precipitating in it the colored compound more or less upon the surface of the fibers.

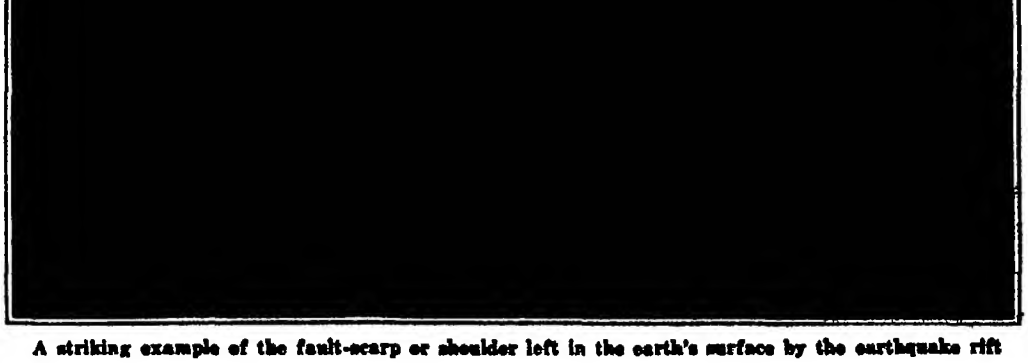
However, to obtain actually fast colors, a still more complicated physical and chemical process must be used, whereby the special coloring material is impregnated uniformly throughout the fibers of the cloth and then developed and fastened *by a method of* "reduction or deoxidizing." This process is so difficult to control in the dyeing of piece goods that even though the best dyers of Europe and America have given years to experimenting to discover a practical method of application, it has only been comparatively recently that this thing has been actually accomplished in a commercial way in England. However, the English method was not suitable for the large production and type of fabrics needed in the United States, and after many months of expensive research experimentation, an American concern improved the English process and put it on a practical basis to meet domestic requirements.

Cotton suitings colored by this process are linen-finished, all-cotton materials, somewhat like beach cloths, but piece dyed by a new process, which for the first time assures a permanent color. This process *does not injure or adulterate the cloth, and the body* of the cloth as well as the colors remain the same after repeated washings. The dyes used are from the anthracene group of vat colors and include such shades as pongee, heliotrope, brown and various shades of tan, as well as blue, green, yellow, gold, corn, light and dark pink and lavender. These colors are actually fast to all modern uses.

They have been exposed for 168 hours and more to direct sunlight under glass, which intensified the sun's rays so that ordinary fabrics would bleach gray in 48 hours. The samples were covered with iron plates, cut with holes and screwed down over the cloth, allowing the sun to shine through on the fabric. At the end of the test there was no perceptible difference in color between the protected and exposed parts of the samples.

These same goods were thrown into a boiling solution of soapy water far stronger than any used in home or laundry, and finally submitted to treatment with acids. The colors were only affected by such chemicals as destroyed or damaged the cloth itself.

These suitings have been exposed to sun, wind, rain and salt air for weeks, on one of the bleakest spots on the Atlantic seaboard, without any appreciable fading. Lye soap and numerous proprietary washing and bleaching agents do not affect the dye. Perspiration and uric acid are equally harmless. In fact, so confident are the makers that these dyes are absolutely fast that they are wholesaling to tailors under a guarantee which covers not merely the value of the fabric, but also the cost of making it up into the finished garment.



A striking example of the fault-scarp or shoulder left in the earth's surface by the earthquake rift

Utilizing All But the Squeal

A Survey of the By-Products Produced by Our Leading Meat-Packing Plants

By Charles Alma Byers

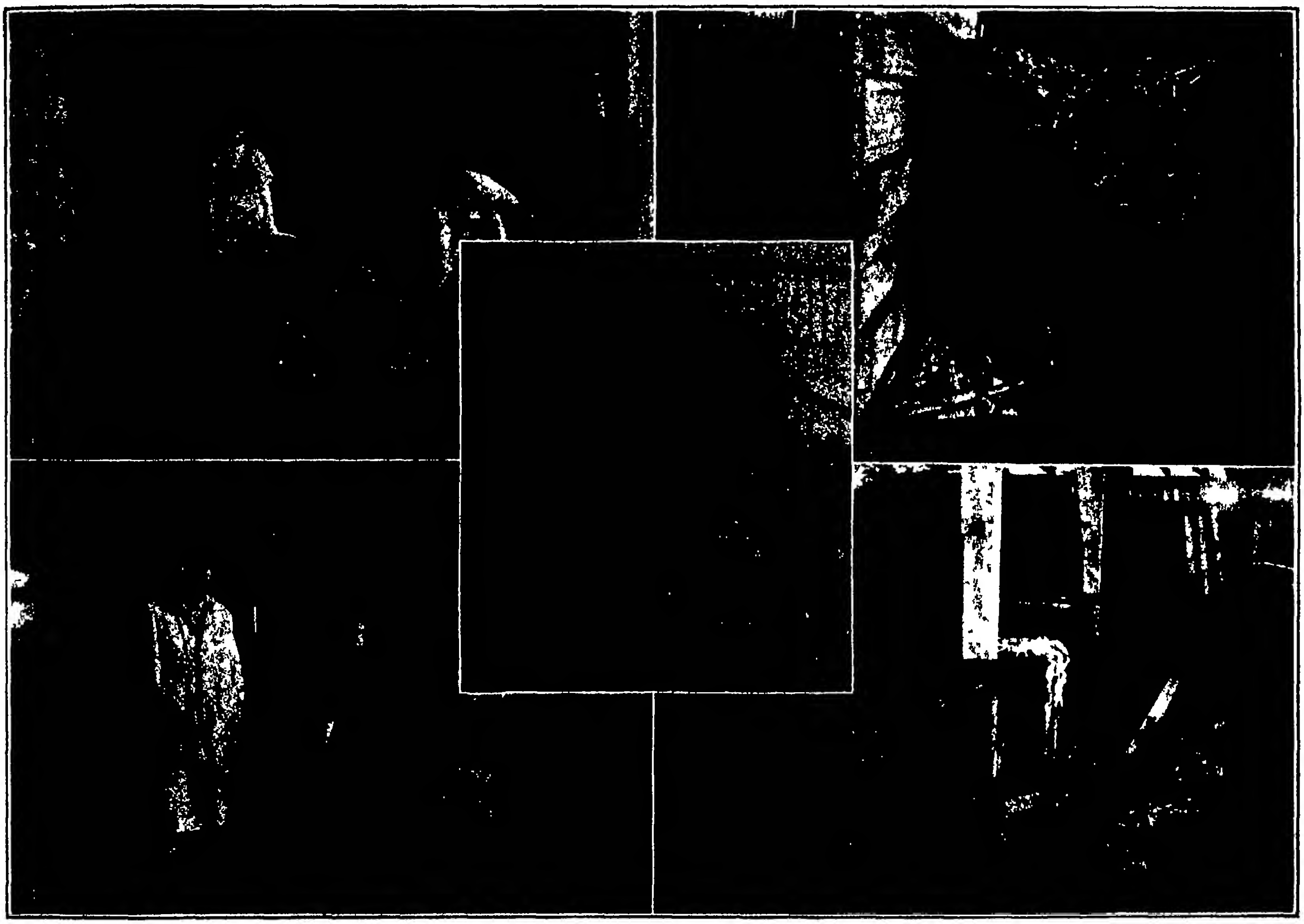
BY-PRODUCT development has doubtless received more attention and been brought nearer the ultimate maximum in the meat packing industry than in any other line of business. Waste in the word's literal or actual meaning, is, at all meat-packing plants which are in any sense progressively conducted, an absolute misnomer, yet from such concerns undoubtedly comes a greater output of so-called waste-products in value, quantity and variety, than from any other one field of industrial enterprise. This has been apparent for many years, with perhaps the result that the idea had come to prevail, with the public, that materially further progress in the direction was not to be expected. Nevertheless, new discoveries and new markets in furtherance of the development of by-products from such source are constantly materializing.

It is perhaps in respect to the use of animal derivatives in medical science that the most interesting development as to by-products in the meat-packing industry has taken place in recent years. The use of animal glands in therapeutics is by no means limited to surgery, nor is it restricted to the use of monkey glands or even to the utilization in the raw state of glands of whatever kind. In truth, gland usage is immeasurably more common among physicians than among surgeons, and it is, moreover, almost exclusively from the domestic meat animals that their supplies are derived. From animals slaughtered for food some two dozen different animal parts and substances are recovered and, in nearly 250 finished forms, employed somehow in medical practice.

Glands and glandular material quite naturally constitute the branch which possesses the broadest and most varied possibilities, both in the matter of sources open to selection and in respect to their uses. In fact practically every known gland in the animal body—lymphatic, thymus, thyroid, spleen, pancreas and so on—is selected and after proper preparation somehow employed in the modern treatment of human ills. And usually the kind or kinds of glands or glandular material selected and prescribed and the nature of the illness or physical trouble for which it is to be prescribed and used are of more or less like character or source. Desiccated blood, or red blood cells, constitutes another much-used animal derivative in medicine, being, because of its percentage of hemoglobin, regarded as especially beneficial in cases of anemia or similar disorders traceable to impoverished blood. Various derivatives also come from the brain and spinal cord, the liver, the gall bladder, and any number of other parts or organs of the meat animal. Then, too, there is, of course, pepsin, which is a proteolythic extract from the glandular membrane of the stomach of hogs. Likewise in this connection it is appropriate to mention benzoated lard, which comprises a very great output. It is quite the same as ordinary lard, or rendered hog fat, to which, however, is added about 1 per cent of benzoin. It is very largely used as a base for ointments.

It is not to be inferred, of course, that these derivatives for medical use are obtained from all or any considerable proportion of the animals killed at the packing plants, nor are they selected promiscuously. Instead they come only from very carefully chosen specimens and the treatment of them following selection is, of necessity, a matter requiring the utmost study and skill of trained experts. Some of them are obtained from the beef animal, some from hogs, and others from sheep and occasionally other animals. In fact, as is thus seen, from out of recent advances or developments in medical science has risen about the packing industry a side-line business that is not only of unique interest but of unusual importance in the monetary sense, with the result that medical laboratories have come to be regarded as a quite legitimate adjunct of the meat packing plant.

The by-products originating from the slaughter of animals primarily for food purposes to revert to the subject in its comprehensive sense, are perhaps almost innumerable. This becomes especially true when it is recognized that different packing companies avail themselves of somewhat different ways of disposing of or utilizing their so-called waste. The field ranges all the way from leather for shoes and a multiplicity of other purposes to a very popularly used ingredient of ice-cream and certain kinds of candy, with glue, household cleansers, hair for mattresses and automobile cushions, fertilizer, stock foods and various other out-



1: Desiccated blood and tankage being mixed for use as fertilizer with two desiccators in the background. 2: Bins of carefully cleaned and assorted bones, used in various by-products. 3: Cattle hoofs waiting to go into the glue-pot. 4: Fertilizer and hog-food in 100-pound sacks, ready for market. 5: Baled hog-hair which, after proper treatment, will probably find its way into automobile cushions.

Some of the scenes that mark the effort to use the products of the slaughter-house to the last penny's worth

puts scattered somewhere between or about these extremes. It has been said, and probably truthfully, that, by giving a little special attention to the matter in a specific case, the by products possible of production from a given animal can be made to exceed considerably in retail value that animal's whole yield of meat. That, naturally is merely illustrative of a possibility, and not a feasible plan for actual adoption

It is leather from hides, of course, which constitutes the one by product of the industry with which we are most familiar because it is the oldest and doubtless the most generally used To undertake even to enumerate the uses to which the leather made from the hides of meat animals is put would be an almost endless task From the hides of such animals, however, come several things besides leather—hair, gelatine, and, indirectly lanolin for instance

As to hair the industry's principal output comes, of course from hogs. Every large meat packing plant has a by product of hog hair bulking into hundreds or thousands of tons annually Temporary disposal of it consists in its being dried and put into bales, of about 300 pounds each Eventually however it is thoroughly cleaned, and then "roped" the latter treatment being for the purpose of giving it curl It is then disposed of for use in stuffing automobile cushions and for other similar purposes The hair from beef animals naturally reaches the market mainly by way of the tanneries and is in demand for various kinds of padding, stuffing for cheap cushions, for plaster bonding and so forth The tail switches of such animals, however, comprise a direct and quite important output of the packing plants. They accumulate to the amount of tons and are disposed of for the manufacture of high grade curled hair mattresses Wool is the hair product of sheep, of course, but it can hardly be regarded as having connection with meat packing for the animals are ordinarily, if not always, sheared before being slaughtered. From this wool both that which is sheared and that which remains on the skin, is obtained the valuable fatty mixture called lanolin, used in pharmacy as a base for unguents—face creams and such preparations.

Gelatine is a particularly important and valuable by product of meat packing plants It is obtained not only from beef hides, but also from the bones and a number of other minor parts of the animal It is in extensive demand, as is generally known, for the manufacture of many brands of jelly powders and other gelatine preparations used in the making of desserts and other edibles, but, as constituting a fact perhaps not so well known by the general public, it is also very extensively used in making ice-cream and marshmallows, for binding and stabilizing purposes, and by bakers and biscuit makers for icings. Large candy factories and ice-cream makers, in fact, frequently order gelatine *from the packing houses in hundred-barrel lots.*

Because gelatine comes from hides and bones is, however no legitimate reason for one to develop any squeamishness over eating it. In its manufacture it is purified and rendered absolutely clean. The first step is to thoroughly cleanse the bones and hides by the application of hot water and steam. This is followed by the process of crushing and boiling out the gelatine, which is held in small cells. The product, at this stage, is in liquid form It is next distributed to a broad running belt and there maintained at a temperature of about 40 degrees Fahrenheit It is thus congealed and brought to sheet form, after which it is thoroughly dried and crushed, to reduce it to the granular state—when, being in a form somewhat like sugar, but of a light buff color, it is ready for the market. About six different grades are made, the stronger the jelly surface which it will yield, the better the grade and the higher the price

The bones which naturally accumulate about meat-packing plants in very large quantities also have by-product value in a number of different ways aside from their utilization in making gelatine. Hence, they are always saved and, moreover, quite regardless of the purpose for which they are to be used, they are invariably thoroughly cleansed and carefully graded They are extensively used in fertilizers and in stock and fowl foods, in each case to add phosphate value The manufacture of these two by-products comprises a very important side-line business of the meat industry, nearly all large packing plants maintaining special departments to carry on this work

Other waste than bones enters, of course, into the manufacture both of fertilizers and of stock foods. These consist of what is broadly termed "tankage"—miscellaneous scraps refuse from entrails, blood, and so forth Blood, which naturally is a very considerable waste output of the packing plant is a particularly prominent ingredient of these by-products. First it is drained to a large tank or vat, and there, when the tank is fairly well filled, quite thoroughly cooked, by means of steam pipes, next, it goes into great desiccators, where it is dried by a method of steam heating, and, finally, it is ground and screened—whereupon it is reduced to the form of very fine powder, of a dark red color

The meat scraps and entrail refuse are handled in very much the same manner The bones which are to be used in these by-products are also ground to near-powder condition Different feeds, as well as the fertilizers, naturally contain different proportions of the elements, and the mixing of the ingredients, which is usually done just before marketing and to meet specific requirements, is therefore done on a basis of scientific analysis. The desiccated blood, however, often finds a market without admixtures, either for use in its pure state or for use by outside fertilizer manufacturers.

It is a true saying that nothing goes to waste about an up-to-date packing plant. Here, therefore, must be mentioned another form of fertilizer product—namely, what is called "stick." It consists of a liquid or semi-liquid waste, produced in the washing and cleansing not only of the meat and other animal parts, but of the floors and rooms generally This "stick" is rich in ammonia, of which it ordinarily contains about 11 per cent, and in other refuse elements useful in manufacturing fertilizers.

Hoofs and horns also bulk to a great quantity around the meat-packing plant They are used, as perhaps nearly everyone knows, in the manufacture of glue, doubtless producing hundreds of barrels yearly Not even the teeth of the slaughtered animals represent literal waste They—like bones to some extent also—are used in manufacturing certain kinds of household cleansers, and in other ways common to the usage of bones.

The intestines of the various animals are also responsible for at least two by products of considerable importance The most of them, of course, are thoroughly cleaned and used for casings—for sausage and similar ground or chopped food. From sheep intestines, however, comes practically all the catgut used in surgery The demands made upon surgery catgut are naturally very exacting, and the manufacturing process, besides necessitating care and skill, is a somewhat complicated and tedious one.

Every Lamp Socket a Radio-Phone

General Squier's Latest Application of Wired Wireless and What It Means in Radio-Phone Broadcasting

By S R Winters

EVERY electric lamp in the millions of American homes is a potential radio-receiving station Displace one of the bulbs (or probably one of the sockets is already unoccupied) and insert the receiving plug at the end of the extension cord in the same fashion as an electric sweeper, flatiron, or other electrical appliance of the household Forthwith music or vocal speech is garnered out of space Thus every city, with electric transmission lines, may negotiate its own broadcasting service and escape the babble of confusion imminent from the amazing growth of the distribution of music, lectures, and conversations broadcast through space

The use of the common office or home electric lamp as a source of supplying the mysterious wave energy for the reception of radio-telephone communications is a fresh application of "wired wireless" or "line radio" a discovery of Major General George O Squier a dozen years ago The applications of this principle of radio-telephony and radio-telegraphy, whereby high frequency currents are guided along established telephone or telegraph wires instead of circulating unaided through ether, unfold with surprising swiftness. Hardly is the bulletin board of the Signal Corps, United States Army, cleared of one scientific contribution before another is crowding for recognition Only recently, announcement was heralded of the development of a "superphone," whereby communications over ordinary telephone could be clothed in secrecy

The demonstration to determine the efficacy of the electric lamp as a source of power for the interception of news, music, lectures, and speech was recently given in the office of the Chief Signal Officer of the United States Army The performance was witnessed by Major General George O Squier, Dr Louis H. Cohen, a noted electrical engineer of the Signal Corps, R. D Duncan, Jr., chief radio engineer, and S Isler, assistant radio engineer, of the radio research laboratory of the Signal Corps, located at the Bureau of Standards. There were other spectators who marveled at the simplification of radio-telephony in terms of a conventional electric lamp a household convenience wherever the services of electrical illumination are intrenched

The group of listeners do not employ head telephones for the reception of music or speech over the electric light line These are easily dispensed with in this instance Likewise, towering antennæ are not needed The instruments consist of a radio-telephone receiver of a well known type with loud-speaking horn, which is suspended on the wall immediately above the receiving set proper May it be said that any standard radio receiving outfit will readily lend itself to effective application for tapping electric transmission lines in this fashion

This particular demonstration was conducted over a circuit one mile in length, with the radio transmitter at one end of the line and the receiving and amplifying equipment at the other the latter being in the office of the Chief Signal Officer of the United States Army Contact with an established electric transmission system may be made in one of two ways. The transmitting station can be connected between the two lighting mains of a city or the alternate of connecting the two mains to a condenser and employing them in parallel may be adopted The latter procedure, according to Dr Louis H Cohen an electrical engineer of the Signal Corps probably offers superior advantages. The radio transmitter employed in the preliminary tests was of standard design as in use by the United States Army The outfit was vested with five watts of power The range of such a broadcasting service, quite naturally, is dependent upon the quantity of power employed at the transmitting station.

The receiving apparatus is provided with a detector tube, another unit for amplifying the music or speech being admitted A high-frequency current, the backbone of "wired wireless" or "line radio," is introduced and modulated in the same fashion that speech over a conventional telephone line is negotiated. These modulated electric waves are propagated along the lighting circuit and tapped off at any desired point A radio receiving outfit is readily connected thereto It should be stated that the transmitting outfit is connected to one point of the lighting main and one point at the ground The use of an antenna is altogether dispensed with

The simplicity of this latest invention makes it a strong bidder for widespread popularity in the millions of homes lighted by electricity The housewife, tired of hearing the buzzing noise of the electric sweeper or having grown weary of applying heat to the flatiron, may substitute these household conveniences alternately with soothing music or knowledge on current subjects by merely plugging-in the extension cord which connects to the simple radio-receiving instruments. A broadcasting service in every city where a network of lighting system permits is the ambitious program outlined by the inventor for "line radio." Major General Squier is quoted as saying "'Wired wireless' or "line radio" will probably do more than any other thing to solve the problems confronting Secretary Hoover's radio conference. The congestion which has recently come about by the increase in the number of broadcasting stations promises to be relieved by this new use of "guided radio." The advantage of broadcasting over electric light wires is that it permits of a local service without exacting the penalty of broadcasting in space from the common antenna, which is now a subject for debate as to the confusion that is likely to result.

For the benefit of the absolute tyro it may be specified that the new system does not enable one to listen in on the broadcasting that is now being done. The lighting system takes the wireless impulses in tow only when it is properly in the broadcasting circuit to begin with, and this is not the case at present.

Stop! Look! Listen!

Automatic Device Slows the Train at the "Distant" and Stops It at the "Home" Signal

By John T. Bramhall

As long ago as 1879, Charles Francis Adams, Jr., while president of the Union Pacific Railroad Company, said, in his book, "Notes on Railroad Accidents," "The effort in America * * * has been directed toward the invention of an automatic system, which at one and the same time should cover all the dangers and provide for all the needs which have been referred to, eliminating the risks of human forgetfulness, drowsiness and weakness of nerves."

In 1907 the Interstate Commerce Commission appointed a board to carry out an inquiry which had been called for by Congress regarding automatic train stopping devices. The report of the board (1911-12) said: "The information obtained from tests (of automatic train-control devices) leads the board to conclude that there are several types of apparatus and methods of application which, if put into use by the railroads, would quickly develop to a degree of efficiency adequate to meet all reasonable demands. * * * In many situations, under existing conditions in this country, the board is convinced that the use of automatic train stops is necessary to the safe operation of trains. * * * The development of the automatic train stop has proceeded far enough to warrant the expectation that by its use greater safety can be secured in the operation of trains. Railroads should be given to understand that the automatic train stop must be developed by them as rapidly as possible."

In April, 1916, following the Amherst, Ohio, wreck, the I. C. C. board of inquiry declared "During foggy or stormy weather, when signal indications can be seen but a short distance, positive and definite instructions should be given prohibiting the running of trains at high speed. Accidents such as this may be expected to occur unless those in charge of the operation of this property at once take steps to see to it, by such check, observations, and other means as may be found necessary, that speed is materially reduced in foggy weather."

The automatic train control committee of the United States Railroad Administration reported, December 31, 1919, "that on lines of heavy traffic, fully equipped with block signals, the use of train-control devices is desirable."

Lastly, the Interstate Commerce Commission has definitely ordered 49 of the leading railroads to install the automatic stop at the densest points of traffic on their systems.

In anticipation of such a ruling of the commission, several automatic-stop systems have been developed and tested. It was during an inspection of one of these by the writer, who rode on the locomotive, that the following episode occurred.

"Yellow!"

The fireman, from his box on the left, called a warning to the engineer, as he had taken it from the signal post just coming into view. We were running into a city not a hundred miles from Chicago, on a down grade. A mile, or less, ahead, was the joint crossing of two busy passenger roads like our own.

The engineer, with hand on the lever, paid no heed. Was he asleep, or ill?

"Watch the air," he said, with eyes afront. The indicator suddenly dropped to 40.

"I struck the ramp at 50 miles," he said. "It was against the rules, and my air was cut off. If it hadn't been for the control, I would have gone on at 60 or maybe better, and likely enough have struck something worse than the ramp."

"But the ramp stopped you?" inquired the "deadhead" passenger.

"No, it didn't stop me, it cut me down to 30 miles an hour. Now watch out, and if the crossing signal is against me and I don't stop, why, I get stopped, that's all," explained the engineer, with eyes on the road ahead.

"And if you get stopped," pursued the "deadhead."

"Why, if I get stopped," replied the engineer, patiently, as the home target showed clear, "that is, if the brakes are set by the valve outside there, why, I have to climb down and release and it's me on the carpet next day. But if I get stopped, I don't run into anything. You get me?"

"And if it hadn't been for the ramp?"

"Heaven knows," replied the engineer. "You ought to see it work in a fog or storm, when it's all we have to depend on. Here we are—so long."

The engineer's brake valve (in dark tone), with automatic control mechanism shown attached on right hand side

The above was an exhibition of the working of the Regan automatic train-control device at the request of the writer who, having been told that the thing was impractical, wanted to be shown. The results were fully convincing.

The signals, clear, caution, or stop, are transmitted to the target, or semaphore, and are read and understood in the usual manner. The connection with the locomotive is made through a ramp, a single length of light rail beside the track, 150 or 200 feet in front of the target. The signal is seen by the engineer half a mile, in clear weather, before the ramp is reached, which gives time to slow down. A contact shoe, somewhat similar to that used on the electric roads, transmits the current from the ramp to the speed controller, which opens and closes electric circuits, depending on the speed of the train. This speed control may be set at any maximum desired.

The centrifugal member of the apparatus is a centrifugal governor, similar in principle to the centrifugal governor of a steam engine or phonograph. It is mechanically connected, for example, to one of the front wheels of the locomotive and revolves, therefore, at the same speed. This governor moves a pair of electrical contacts, opening them when the engine (and governor) speed exceeds a predetermined maximum, the 'proceed with caution' speed for which the governor has been adjusted. These contacts, in turn under certain conditions control the air-brakes through an electro-pneumatic valve as follows.

When operating on track between ramps, or when a "full proceed" indication is picked up through a ramp contact (or its equivalent, absence of cautionary signal), the electro-pneumatic valve controlling the air-brakes is energized by a storage battery carried on the tender and the governor is not involved in the control. This is the condition when the train is running in a clear block.

When a train passes a signal in the caution position the combined action of the control current received from the roadside apparatus and the change of electrical connections on the locomotive effected by the contact of ramp and shoe, inserts the centrifugal governor contacts in the circuit and thereby puts the air brakes under its control. If the engine's speed exceeds the predetermined "caution speed" for which the centrifugal governor contacts are adjusted, the speed-governor contacts are separated, the electro-pneumatic valve is de-energized, brake-pipe vent opened and the brakes applied. At the same time the electro-pneumatic valve closes the reservoir supply to prevent the engineman from releasing the brakes manually.

When the speed of the centrifugal governor has been reduced to the point for which it is set, its contacts close once more and release the brakes by a reverse procedure. If the engineman allows the train to speed up once more while the caution indication is being received through the ramp, the centrifugal governor once more opens the circuit which controls the electro-pneumatic valve, which in turn controls the brakes, and the brakes are applied until the speed is reduced to the predetermined maximum, and then it once more releases them.

When a stop indication is received through the ramp, the electro pneumatic valve-circuit is opened external to the governor, and the brakes applied, irrespective of governor position.

It is important to note that the initiative remains with the engineer, and only when he fails to respond to a signal indication does the speed controller, obeying orders received through the ramp, do the work for him. The engineer cannot increase speed while the locomotive is in the low speed area nor if brought to a stop by the ramp, can be proceed without descending and releasing the valve. If, on passing over the home ramp the stop signal is not given, he may proceed at schedule speed. No unnecessary stops are caused and it is claimed that better time is made in bad weather with the aid of this device than without it. In answer to an objection that so delicate a mechanism as the speed controller attached to a locomotive journal would be liable to get out of order it was said that one had been in service for about 75,000 miles, and another for 50,000 miles, without repairs. The entire cost of maintenance of the automatic control on this division in the initial operation of last year, I understood was about half that of the interlocking signal and crossing protection, which it supplements and strengthens.

Examples of practical operation might be multiplied. The history of automatic train control is 20 years old. Among various forms of automatic train control mention may be made of that on the Chicago & Eastern Illinois (107 miles double track since 1912), Chicago, Rock Island & Pacific (21 miles double track since 1919), Chesapeake & Ohio (19 miles single track, with announced intention of extending installation eventually over the entire system), Western Pacific in California and the Interborough electric lines in

This view shows the location of the separate parts of the complete automatic apparatus on the locomotive

New York As a result of recent hearings before the Public Service Commission at Albany and the recent action by the Interstate Commerce Commission, it may be stated that the New York Central has undertaken a service test of a train-control device of the induction type on the Mohawk division, a test which is expected to set the pace for a standardization and general adoption of automatic train control on trunk line railroads.

It is quite unnecessary, I am sure, to bring forward any arguments, or to marshal statistics to show the urgent necessity of the adoption of some sort of automatic train control That has been done on frequent occasions in the columns of this journal Therefore, I shall not call the evidence of the all-too-numerous collisions and other forms of train wrecks and the thousands of lives annually sacrificed (and many thousands more maimed for life), of passengers and employes alike The facts are admitted The need of relief is recognized by the railroad executives, but they are between the devil and the deep sea On the one hand are pressing demands for maintenance improvements rolling stock, motive power and labor which now claim first consideration instead of last On the other hand, are the difficulties of raising money in the face of diminished earnings. Railroads are obliged to have money to operate and they must operate profitably in order to get money The management dreads collisions Eventually we look for a rapid and widespread adoption of the automatic stop

The ramps, one on each side of the single track. For one-way traffic only one of these 40-foot rails is necessary

Left: The centrifugal control attached to leading wheel of locomotive. *Right:* Close-up view of shoe which makes contact with the ramp

Two-Cent Gasoline—A Pitfall for the Unwary Investor

THE elements of comedy and tragedy were curiously combined in a Mineola, N Y, court-room recently, when one of the most persistent of the "inventors" of synthetic gasoline had his day in court This was the man whose mysterious green fluid, introduced into a mixture of water and peat, was claimed to result in the distillation of a motor fuel at a cost of two cents per gallon, and he has had a great deal of attention in New York papers and those of other cities as well Sued for obtaining money under false pretenses, he arranged for a court room demonstration, with the understanding that the case against him was to stand or fall in reverse ratio with his success or failure to make good on his claims. Needless to say, his "demonstration" was a complete failure, and the court refused to grant him another chance Whether or not this "inventor" was a self-deluded visionary does not enter into the discussion of the many schemes which for the past eight years have been stimulated by the quest for cheaper gasoline

Dr Raymond F Bacon, formerly head of the Mellon Institute, has devoted a large part of his professional activity for several years to the investigation of such claims. His experience is that the majority of the claimants are deliberate frauds and, within their abilities, tricksters as well An oil which can be used as a motor fuel, he points out, can by well known means be distilled from peat—but at a cost of several dollars a gallon This lends peculiarly to fraud, since the prospective investor can test the performance of the alleged cheap fuel more readily than he can verify the statements made to him about its low cost of preparation. In spite of this, however, most of those who have played this variation of the get-rich-quick game have done so on a trifling scale, which involves actual sleight of hand in the performance test, rather than an above-board test of a fuel actually produced at excessive cost from peat, water, etc. "Inventors" of these "cheap fuels" are usually temperamental folk, who have to be left alone for a while at the critical point of the operation, in order that "the secret shall not be revealed" prematurely, or for some other entirely good (?) reason. It has been found that gasoline or tar oils of some kind are quickly substituted when no one is looking. One inventor had a still which he led his dupes to believe was producing gasoline out of a mixture of water and a white powder As a matter of fact, he placed gasoline in a tank outside of the building where his experiments were conducted, and this fluid passed through the still from a hidden pipe What was actually obtained was a good quantity of real gasoline which the promoter put in the tank of an automobile Naturally, the mileage made by his mysterious fluid was about the same as that which could be obtained from any good quality of gasoline

Another inventor told those whom he wished to interest that he could run an automobile with a mixture *composed half of sea-water and half of a mysterious* preparation of his own He first put the sea-water into the tank of the automobile and put in an equal amount of his own fluid fuel The car ran very well, for what the inventor put in was pure wood alcohol, and the resulting mixture, being 50 per cent alcohol, burned fairly well. In a similar case, but for the interference of a strong-arm man, who found that the inventor had under his waistcoat two rubber hot-water bottles filled with alcohol, the deception might have worked.

Some of the inventors of gasoline processes foist upon the public a mixture of kerosene to which is added a little ether The effect of the ether is to give a quicker ignition, but as this fluid is very costly the motor fuel of this kind really costs more than the gasoline for which it is supposed to be a cheap substitute. Undoubtedly cheaper substitutes for gasoline will be made eventually and at the present time there are mixtures of alcohol and tar oils which although more expensive than gasoline have many good qualities.

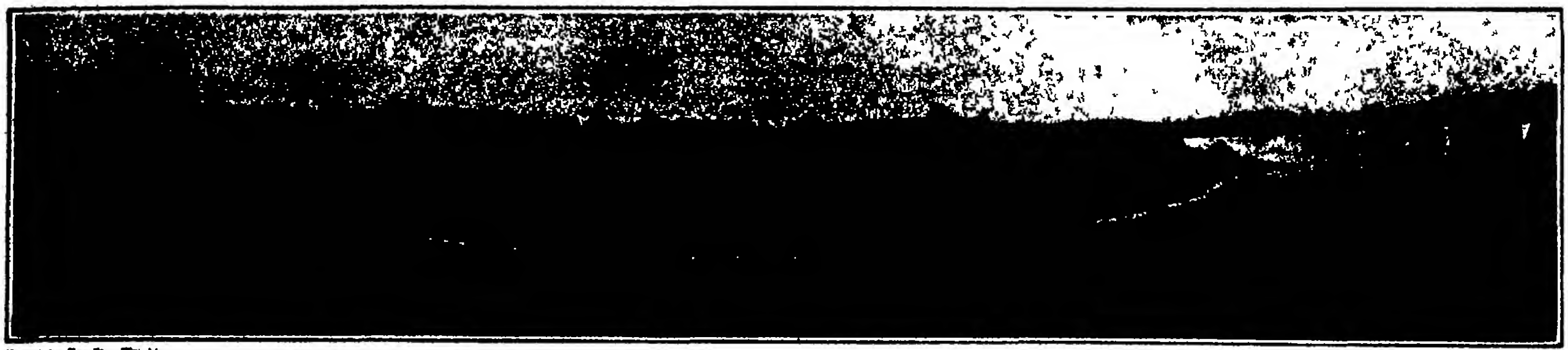
It should be borne in mind that all the large petroleum refining companies are spending many thousands of dollars in research work in order to find lower priced gasoline or motor fuels. Any inventor, for instance, could interest the large corporations and perhaps reap a rich reward in royalties if he could convince them that his process would make gasoline at eighteen cents a gallon. The idea of manufacturing this fluid at two cents a gallon is a preposterous one, and beyond the realm of common sense. Any person who is considering the purchase of the patent rights of a process for making cheap gasoline would do well to consult a petroleum chemist, for past experience has shown that there are many pitfalls for the unwary into which those who are not familiar with chemistry are likely to tumble.

The Sex Detector Exposed

NUMEROUS so-called "sex detectors" have been brought out during the past few months, in behalf of which the most extravagant claims have been made These instruments have in almost every instance been plummets or balls of some sort suspended at the end of a string One was of nickel-plated iron filled with a greenish mixture of calcium carbonate and an aluminum salt Another was a small wooden ball, gilded and filled with red lead. A third was a slightly soft, slightly gummy composition of some unknown identity—solid or hollow we do not know, since the one we saw was not ours to cut open

All of these devices "work" in the same manner They are held at the length of their suspension cords above the object to be tested If the verdict is "male," *the bob is supposed to swing back and forth like a* pendulum, if "female," to describe little circles at the end of its cord, if "neutral" like an infertile egg, the bob is supposed to stand motionless. There is no claim that is not made for the sex detector, it is alleged to indicate without possibility of failure the sex of an unhatched egg, of oysters, of butterflies, of beetles, of caterpillars, of worms, even of the animal from which products like leather or cheese come—though a verdict of "male" in the latter case would have its bewildering features. Even the sex of the person who had shed dried blood found on weapons or clothing was claimed to be instantly determinable

It should hardly be necessary to say that there is absolutely nothing at all in this business. When the manipulator of the device knows the verdict which should be rendered, he consciously or unconsciously gives a muscular reflex that directs the bob in the appropriate path When he is ignorant of the sex to be determined or of the motion which the bob is supposed to yield under known circumstances, either the detector stands motionless or achieves the 50 per cent of correct guesses to which it is entitled. Nor is the "detector" in the least degree consistent. Tests by different persons on the same group of eggs or other objects are widely discordant. In the absence of any scientific explanation of the alleged working of the apparatus no such investigation as this should be necessary to set the issue at rest; but query and credulity have been so persistent that the United States Postal authorities and the editorial staff of the SCIENTIFIC AMERICAN have both been driven to make the tests outlined.



Copyright Hamilton Wright

Guatemala's relief map, two acres in extent, that shows every topographical and cultural feature of the country

A Relief Map That Fills Two Acres

THE republic of Guatemala, in its endeavor to make it easy for visiting capitalists to see what they are investing in and to decide on the merits of proposed investments, has built and set up what seems by all odds the most extraordinary relief map in the world. This map is two acres in extent, and shows every contour, every town and every stream or lake in Guatemala and the neighboring territory of British Honduras. It is surrounded by water representing the Atlantic and Pacific Oceans.

The giant topographical map is of concrete, assembled in sections. Almost two years were spent in making the molds, and in checking them up. The ultimate cost of the map was $100,000, and another like sum was spent in gathering the topographical data on which it is based.

The big map is located in the hippodrome or racetrack at Guatemala City, and its substantial character is indicated by the fact that it has passed through two earthquakes without harm.

Moving a House of Glass

By F. G Jopp

FOR two months recently one of the most delicate jobs of structural moving ever recorded was in progress at one of the big motion picture studios in Los Angeles. It consisted of moving one of the huge glass stages—a shed like structure, 50x150 feet, and containing 3884 panes of glass—across rough ground to the side of another similar stage.

In addition to the moving operation, it was also necessary to put the fragile structure in exact register with the other stage, in order to make the two into one complete studio.

It was first intended to demolish the stage, move the material, and rebuild the structure at the new location About this time a local moving firm successfully transferred a complete hospital from one site to another without disturbing the patients, and the idea occurred to the motion-picture men to undertake the moving of this delicate glass affair, with no supporting interior walls, intact

Because of the nature of the building, the task was made doubly hard. A glass studio consists simply of four walls and a roof. There are no interior partitions or supports to give it rigidity When it is remembered that this huge building is 50x150 feet in size, it can be readily seen that the job of moving it was an undertaking of great delicacy, especially so in view of the fact that the four walls are entirely glass, pane after pane leaded together A slight strain and hundreds of panes would be shattered. And, in addition, the huge affair had to be placed within a fraction of an inch of the desired spot.

The moving company first secured some extra long 12x12 timbers. Undermining the building, the timbers were run under the structure while the structure was still on its foundation. Jacks were then inserted under the long timbers at frequent intervals and a man assigned to each one. Slowly and carefully turning in unison, these men lifted the building about three feet above the ground Meanwhile the picture companies were hard at work overhead in the studio

A sharp turn in the track, showing the slant by means of which the rollers were constrained to follow the desired course

Lifted clear, the next step was to construct a special track, the idea of the foreman He arranged this in such a way that the studio would, in its travel, follow the intended course, through the natural "roll" of the rollers on the track In other words, the combination of leverages was worked out so that it took the place of flanges on wheels.

This done, the studio was let down on to rollers which were placed on the track All was then ready for the actual moving

One team of horses, with a windlass, was stationed at the point the foreman calculated was the proper place to give the right leverage for his tracking system. The horses were then started and the studio rode in perfect fashion to the exact spot calculated.

A structural steel section was then inserted between the two studios and the one that had been moved was lowered into place and the two riveted together

Not a single pane of glass was broken in the studio and not for a moment was the work of production of pictures halted

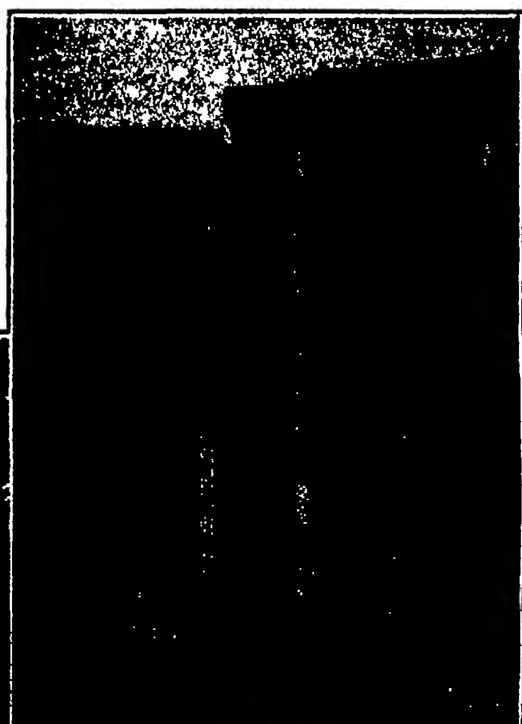
The resultant studio is 100x150 feet—one of the largest glass stages in existence It will give a floor space of 15000 square feet, unrestricted by beams or other hindrances Thus the largest street scenes can be built indoors under the glass. The ingenuity of the moving concern accomplished in two months of leisurely work what would have required at least six months to do had the tearing down and rebuilding been undertaken

Photography of Stars in Full Daylight

IN *L'Astronomie* for October, 1921, is a short article by M Maurice Hamy on this Experiments were successfully made by Messrs. A F and F A Lindemann in England in 1910 They succeeded in photographing stars down to the third magnitude near midday and indicated their belief that fainter stars might be photographed quite near the sun in a fine climate *e g*, in Kashmir or on Mount Wilson

M Hamy has performed numerous experiments with a small apparatus designed for testing the purity of the atmosphere at various localities. He concludes that with objectives of moderate aperture (as for example 13 inches) it should be possible to obtain clear images of stars down to magnitude 6, with an exposure of a half hour Special plates, sensitive to the infra red rays of light, and deep red filters to cut out all other colors, are required for this work and the atmosphere should be as free as possible from haze

The particular problem to which this method may find immediate application is the testing of the Einstein hypothesis, that light rays are subject to deflection in passing through a gravitational field The apparent direction of a star whose light just grazes the surface of the sun should be changed by nearly 2" If this method becomes successful for the fainter stars, it will not be necessary to rely on the few minutes of total solar eclipses for testing the Einstein theory



Left: Ready to start moving the huge studio building containing 3884 panes of glass. *Center:* Putting in the connecting link. *Right* The two studios joined into one

Moving a film studio across rough ground and joining it to another, one of the most delicate jobs of structural moving on record

Planning Big Crimes

Some of the Details that Precede the Actual Commission of a Notable Robbery

By Roy A. Giles

If we were asked whether the subject of this article is in our field, the answer would doubtless have to be "No" Neither was Mr Giles' story "Science in Safe-Breaking" in our December issue; or Dr Simon's article "From Opium to Hash Eesh," in the November number, or our account of "Stamp Frauds and Their Detection," in the January issue But all of these articles aroused wide interest and evoked a good deal of comment, and, in a way, it is appropriate for us to tell how science and scientific methods are used in the commission of misdeeds. So we have had no hesitation in putting the present interesting story before our readers.—THE EDITOR.

THE commission that plans a city beautiful, the engineer who gives reality to a sky-scraper, and the inventor who evolves a wonderful new mechanism, plan no more carefully than does the "highmobsman" or master mind of a "gun mob" or gang of crooks. The recent $1,500,000 mail-truck robbery in New York, where the crooks had more definite information about the registered mails than the Postmaster General himself, and other crimes of an outstanding nature, would completely mystify one unfamiliar with crooks and their ways. However, here and in all other cases, there are certain marks which reveal to the skilled detective or criminologist just how the thieves set about their plans. Once one knows the cunning little ways of the brainier crooks it is plain that they do not go about a job without a very clear idea of what they may hope to get, and how they may expect to get it.

Planning a big robbery sometimes begins with a bar of soap—of which more later Sometimes it begins with a pretty girl Soap is put to many uses by the more accomplished crook so are pretty girls—and girls who are not so pretty Sugar is often added and served with the pretty girl, to corrupt someone from whom information is needed. "Sugar" in this instance does not mean something sweet, it is just one of many crook words for coin of the realm.

An outsider corrupted by thieves who need the information he can furnish is an old, old story Such a one is seldom if ever a real member of the band. He is the "sucker," the "simp," the "boob," the "hick"—or something equally uncomplimentary and less printable He is milked of all needed "dope" and then he is often murdered. An instance of recent record is Benjamin Binkowitz, youthful bank runner of New York, who was used as a tool by an Italian "mob" in the robbing of Wall Street brokerage houses of large sums in negotiable securities. His body was found, terribly mutilated, where it had been thrown against a wire fence from an automobile on a lonely Connecticut road. Binkowitz got the bonds, got the information as to when and where other runners might be intercepted with valuable loads, he had met his "pals" in a road house near Bridgeport they had given him one grand orgy after the manner of the Camorra (Italian crook mob), with girls, music and "booze", then they had taken him to his doom

Girls are often used by crooks without their knowledge I call to mind three show girls who married handsome and seemingly refined men, to learn later that they were crooks Many others have been used to get needed information about wealthy men or big business houses. These girls "vamp" their victim until he "falls" for them then they work the information out of him in one way or another Such information may be for use in a crime that is being planned, or it may be for blackmail. Some of the girls have no idea, at the time, of the purpose for which the gossip that they pass along is wanted If the girl is actually corrupted and becomes a decoy, "stall," or tool for the crooks, either for the sake of a man or for money, that is another matter Then she becomes a "gold-digger" and often becomes a bit of a crook on her own Sometimes she succeeds in keeping within the law, again she slips all the way down to the bottom rung of the social ladder and finally fills the grave of a drug-crazed suicide.

There is the notion that the girl crook is peculiarly liable to turn state's evidence on the arrest of her male pal And there is the idea that the girl in the case would rather die than aid justice Both ideas are right—and both are wrong it all depends upon the girl. There are all kinds of girls, and all are peculiar, Adam was probably the first man to observe this. The only way to tell how the girl in any case will behave is to try her, and see.

Some of the crime cases which I can call to mind are so intricate so weird and so startling that I know how to account for the use of superlatives in the newspapers. However, the papers seldom print all the emotional and psychological facts back of a crime, unless it be a murder with sex interest, from day to day they pass from crime to crime and space is too valuable to tell any of the stories in detail.

Probably the most carefully planned and unusual item in American crime annals is the story of one of our large northwestern cities, which for some time was administered by and for the crooks. It wasn't Duluth and it wasn't St. Paul, so we may refer to it as Dupaul. Some time before the commission form of government became prevalent, certain crook mobs were "making" the cities between the Lakes and the Coast, under such official protection as was available. These gentry decided that they ought to have a real base, where protection would be surer and official graft not so profiteering as it is apt to be when it crops out spontaneously In the conspiracy which was cooked up there were a gang of strong-arm workers, one of pickpockets, one of second-story workers, one of shoplifters, one of "fences," a gambling ring, an army of women directed by a competent "mouthpiece" or lawyer, a group of badger workers—and others too numerous to catalog. They were all good spenders and they all made friends around Dupaul. They finally succeeded in electing their mayor, whose life in and out of jail is now a matter of court and police record. Strong for lewd women and graft money, he was a near-crook, a crook sympathizer and a crook protector As mayor he saw to it that the chief of police was the "right" person. The force itself was made up of low characters, grafters and riff-raff generally A white girl or a white 50-cent piece was as safe in the hands of that police force as a mouse would be in the claws of a starving cat.

In those halcyon days for the crook mobs of Dupaul the police used to seek out the places to be robbed and stand "stall" or look-out during the commission of the crime If no truck was handy they would call out a patrol wagon to take the loot away Safes were carried off bodily and blown open in the railroad yards. If a citizen happened along and tried to interfere, some near-crook picked a fight with him, and after he had been well beaten up he was jailed for creating a disturbance Nearby thrifty towns were raided and money rolled around the underworld of the metropolis of crime like hailstones during a storm Occasionally, by way of diversion, a train robbery was indulged in. One Great Northern express hold-up netted more than a million dollars in gold bullion. The stuff was carted into saloons and hidden behind bars. Bartenders had hack-saws handy, and when a crook needed funds they would saw off a chunk of gold about as a housewife would slice a loaf of bread for little Johnny and sister Sue.

Finally the Federal Government went into the crook-ridden city and, with the aid of the honest element, there was one grand round-up. A choice assortment of city officials was included in the group that went to the penitentiary Those who escaped fled to Denver and tried to get control there, but were not able to make it go One of them served a life term for the murder of a Denver policeman, another "got his" for a 10-year stretch in Canada, and the crowd was finally thoroughly broken up.

One little incident in the crook administration of another town is worth telling. One night they wanted to rob a bank. To attract the townspeople from the section where the bank was located they got the fire chief to start a nice large blaze in another part of town. The fire chief out-Neroed Nero. He couldn't play the violin, but he came pretty close to burning up the city. With some of his followers he later took up residence in another part of the State, where the styles run to horizontal stripes. The school director, however, was a luckier or a better man; he outlasted the fire chief by 15 years, during which he maintained an exterior of the utmost piety and honor while hiring cracksmen to rob the school treasury in his interest. He was prominent in the church and the Sunday school, and director in a couple of banks. The banks blew up when he blew.

One city which we may fairly name here is Peoria. Because of its strategical position between Chicago and St. Louis, it is the handiest place in the world for a big-town crook to be able to lay up in, and the crooks of Missouri and Illinois are always casting hungry eyes upon the city government. Peoria in fact has had its ups and downs in dealing with this situation, but finally, in Mayor Woodruff and Police Chief Rhodes, they found the proper combination to deal with the menace. They reelected this pair for a succession of terms over a period of 18 years, with the ultimate result that Peoria had to close its workhouse for lack of patronage, and the town is now as clean as a pearl.

One bright afternoon a tall, handsome fellow walked into police headquarters in Denver. He was from the Coast, and had a line of talk which supported his claim of intimacy with many detectives and patrolmen in San Francisco and Los Angeles. He made himself liked, and after he had got a good job he continued to put in his spare time around the police stations.

This fine chap's name was Hastings, and he had just finished a sentence at San Quentin for bank-robbery. He was not of the safe-cracking type, but depended on his brains to get the money, and he possessed ingenuity and persistence worthy of a better cause. All by himself he reconnoitered the Denver banks. He finally selected Elwell's private bank as his victim. He laid swift court to a young widow employed here, married her after a few weeks, and then for a couple of months was with her about the bank as much as possible, while keeping the marriage secret so that his wife might retain her place.

Sometimes in his capacity of his wife's gentleman friend Hastings actually waited on customers of the bank. Learning that there were two keys to each safe-deposit box, one held by the bank and one by the box-owner, and that both were necessary to gain entrance to the boxes, he made a bar of soap a permanent part of his equipment. He took soap impressions of all the bank's keys; and when patrons came in he would ask to see their keys for a moment for verification and thus have opportunity to get impressions of them, too With a "pal" who had shown up from "back home" and who posed as the son of a prominent family in Southern California, he fashioned duplicate keys and planned the robbery

The "son" of the prominent family called on Elwell when he was alone in the bank, "to rent a safe-deposit box" Hastings was waiting just out of sight with his bunch of keys. When Elwell turned his back to his prospective patron for a moment, he received a clout back of the ear with a blackjack. But an accident saved the day for law and order; the blackjack broke and spilled shot all over the place, the blow failing to do more than arouse Elwell's fighting blood. The banker weighed nearly twice as much as the crook, and when detectives arrived in response to a burglar alarm the Californian was thoroughly subdued, with Elwell sitting on his chest. A confession was followed by the arrest of Hastings and his conviction.

Soap, used more or less as Hastings used it, is one of the crooks' stand-bys. A few underworld characters once robbed the New York sub-treasury of somewhere between two and five hundred thousand dollars, in gold bullion, by using only what brains they had, plus a cake of soap. "Red" Dugan planned this robbery, which was a gem. He located a place where sub-treasury employees ate and drank; and here, with a small bar of soap concealed in his palm, he stumbled against one of these workers. Apologies were offered and accepted; but in the meantime, during the collision, Dugan had pressed his soap against the other's badge and got an impression thereof. From this he had identical sub-treasury badges made for all his band, including a well-known forger whose services were necessary. By corrupting a waiter in the restaurant he succeeded in buying advance information as to when a shipment

(Continued on page [illegible])

Outdoor Auditoriums of Novel Design

THOSE of us who have ever spent a summer or a part thereof at Chautauqua, N. Y., or at any of the little Chautauquas in other parts of the country, are sufficiently aware of the fact that an auditorium does not necessarily have to possess a full complement of four walls and a roof. Performances are being given, and exhibitions held, more than ever in structures to which the adjective open-air may fairly be applied. And the architecture of these buildings displays a surprising possibility of variation.

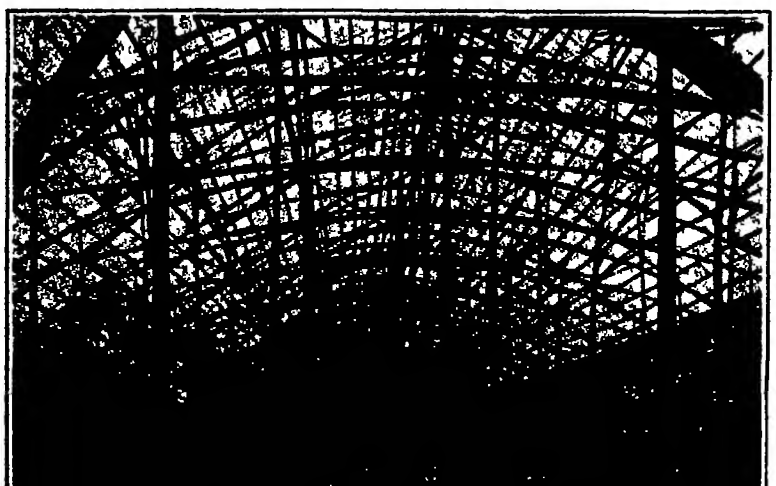
Tokio, for instance, has been holding a Peace Exhibition; and it was desired to have an open-air auditorium for concerts and similar performances. Provision is in this instance made for sheltering only the performers; if it rains, the audience must get wet or go home. The stage structure is of concrete, laid on bamboo forms in the shape of a multiple-arched vault closed at the back and sides save for a single entrance-and-exit door at one side. It is wide open in front, and one can imagine that it acts as a remarkably efficient sounding-board, making the performance audible to an extraordinarily large audience.

Vaulted stage and sounding-board of concrete in which open-air concerts are given at Tokio

Another interesting construction is the bamboo-and glass shed in which was housed China's first automobile show, recently held at Shanghai. Motor-car manufacturers from America, Great Britain, France, Germany and Italy were among the exhibitors, but to an automobile-surfeited public like that of America, by far the most interesting feature of the exhibit is the building in which it was held. This was apparently put up for the occasion; our photograph shows it in process of erection, and makes it almost unnecessary for us to comment upon the manner of its construction. The roof and walls are in part of the matting shown piled up on the floor, but in large part of glass. The notable feature of this construction would appear to be the size of the building which can be put together over a framework of such small-caliber members.

A Paris theater with a pneumatic roof that is put in place and inflated when it rains. The two photographs show this novel roof from within and from without

The most surprising of the views on this page, however, are the exterior and interior shots of the Oasis Theater in Paris. This is a genuine open air proposition, in that the performers and the audience alike are located out of doors. In fine weather there is nothing to the theater but a floor and seats. When it rains, a huge pneumatic hollow rubber roof is rolled into place over a light framework that surmounts the floor, and blown up just like an automobile tire.



Shanghai's bamboo shed of automobile-show proportions

Don't Paint Your Oil Tank Red

"PAINTING the town red," is an imaginary condition of fascinating appeal to the adventuresome spirit. Similarly, using a brilliant color to decorate tanks and reservoirs for storing oil from gushers in the oil fields has added zest to the building of fortunes from gasoline, but the practice has proved to be a costly one. White paint as a covering for oil tanks is less ornate and not as stimulating to the eye but it reduces the losses of the crude oil from evaporation, if we are to accept the word of no less an authority that the Bureau of Mines, United States Department of Interior. This government bureau recently conducted a series of tests which developed this interesting conclusion.

Evaporation—to fly off into vapor after the oil has been taken from the ground—is the biggest loss sustained by prospectors once they have robbed a gusher of the valuable liquid. A government estimate places this wastage at 122,100,000 gallons a year, which, computed in terms of 22 cents a gallon, has a valuation of $26,880,000. *This loss represents 3 per cent of the entire* gasoline production of the United States from all oil fields and other sources. Observations have shown that a 250-barrel tank, maintained for five days in the summer, will be robbed of 2.8 per cent in volume by evaporation. The loss in winter, of course, is not so heavy, being not quite 2 per cent of the volume in storage. Records kept of the losses sustained by eight 55,000- and 37,000-barrel steel tanks in Texas approximated 5 per cent during the first two years after storage.

Various methods have been devised for curtailing this drain in recent years, notable among the discoveries being that an all steel tank of gas tight construction is the most efficient container for oil. That the color of the paint used in covering these tanks is an influential factor in increasing or diminishing the toll paid to vapor is one of the recent findings that will ultimately contribute to the efficiency of preservation of our gasoline supply. Tests by the Bureau of Mines have demonstrated that oil containers painted white average from 1 to 1½ per cent less loss from evaporation than tanks decorated with red paint. Black paint is even more costly as a contributing factor to wastage, taking a toll of 2½ per cent more than white paint. The explanation for this difference is that dark-colored paints absorb heat to a large degree.

Small tanks containing benzine were decorated in varying colors (gloss finish) and subjected to the influence of a powerful arc light for a period of fifteen minutes. The rise in temperatures at the expiration of this time showed the following results with respect to the color of paint or covering: Tin plate, 19.8 degrees Fahrenheit, aluminum paint, 20.5 degrees; white paint 22.5 degrees; light-cream paint, 23 degrees; light pink paint, 23.7 degrees; light blue paint, 24.3 degrees, light gray paint, 26.3 degrees; light green paint, 26.6 degrees; red iron oxide paint, 29.7 degrees; dark prussian blue paint, 30.7 degrees, dark chrome green paint, 30.9 degrees, black paint, 44 degrees Fahrenheit.

The conclusions of these experiments indicate that tin plating and aluminum paint were the most efficient in withstanding the aspirations of the thermometer. These products, however, are not adapted to use as outside covering. Iron coated with tin yields readily to corroding influences, and aluminum paint very soon robbed of its gloss becomes flaky. The results of these tests indicate that the rise in temperature of the benzine in the tank painted black was 31.5 degrees Fahrenheit greater than the rise indicated in the container having a white covering. Allowances should be made for laboratory experiments when the results are taken and applied to the conditions of the oil fields, but the advantage of painting oil tanks white is obvious.

Diesel Engine Wins Its Way

Substitution of Heavy Oil Engine for Steam Engine in Harbor Lighter

A NEW type of harbor freighting equipment which will have an important bearing upon cargo handling, and will ultimately effect a considerable reduction in the cost of freight transferred by water, has recently been put into service. We refer to the derrick lighter "Worthington," which is propelled by a Diesel oil engine, and is the first of its type ever built. It is unique among harbor freight handling craft for the reason, also, that the power for propelling the boat, operating the freight handling derrick, lighting the vessel, etc., is also obtained from Diesel oil engines. For many years the company, after which the boat is named, has operated in this harbor and tributary waters a large steam derrick lighter. This service is of such a character as to involve large standby fuel losses, for the reason that the boat has to be alongside docks or ships for a large part of the time, during which time fuel must be burned constantly to keep steam in the boilers. In designing the new vessel it was decided to take advantage of the economies made possible by the heavy-oil engine, provided it were designed in a qualified form adapted to this particular service, the designers realized that not only would a Diesel lighter have no standby losses, but it would produce much more power per pound of fuel used than is possible with the steam engine. The steam lighter must keep its furnaces going day and night; the Diesel lighter consumes not an ounce of fuel while it is lying idle.

The "Worthington" is a wooden vessel 138 feet long, 35 feet wide, and of 10 feet draft. It is built very heavy, to withstand the hard usage incident to service around the crowded docks of New York harbor. Her outstanding feature is the steel derrick of 20 tons lifting capacity, whose boom 90 feet long is stepped on a tripod 7 feet above the deck. The great length of the boom permits the boat to lie alongside high-sided ocean ships, and handle freight directly to and from the ships' decks, without calling upon the ships' own cargo-handling equipment.

The main engine for driving the vessel is a 2-cycle, 4-cylinder reversing Diesel engine of 300 horsepower, built by the company from its own designs. It is direct-connected to the propeller shaft. A 2-cylinder, 50-horsepower engine drives a 38-kilowatt generator, current from which serves to operate the derrick, all the auxiliary pumps, the electric lights, etc. For lighting the vessel when the larger auxiliary is not in operation, a small Diesel engine operating a 6-kilowatt generator is provided. The hoisting equipment is located in the hold just forward of the engine room, and the wire cable from each drum is led by means of pulleys up through the deck to its proper connection on the derrick. We present an illustration of this hoisting equipment, with its winding drums, brakes, and friction clutches. The control is from a glass-inclosed operating room, placed at a good elevation in the forward end of the deckhouse, immediately below the pilot house. The hoisting drums are operated by an electric motor, and therefore the starting and stopping are effected by a controller, similar to the ordinary street car controller, located in the operating room.

The use of oil results in a degree of cleanliness and comfort in both the engine room and living quarters, that is unusual on harbor lighters. Furthermore, the consumption is so moderate that the boat has a larger radius of action without re-fueling, than is possible with the steam lighter. Fuel may be taken on at the most convenient time or place. Since boats engaged in freight lightering are essentially rovers, they are liable to find themselves successively at many different points in the harbor or adjacent waters. If a Diesel engine lighter is in the vicinity of an oiling station, fuel tanks can be quickly filled, and since fuel consumption is so small it is rarely, if ever, necessary, as in the case of steam vessels, to interrupt a job to go after fuel.

The steam lighter possessed by the company is of the same size as the new Diesel lighter, although its derrick is only about one-half the capacity. Hence, it is possible to get a direct comparison of fuel costs for the two boats. Taking an average month, during which the boats were under way 50 hours and tied up to the docks the remainder of the time, the coal bill for the steam lighter was $1100.00, whereas the new lighter will give the same amount of service on a fuel bill of $250.00. This means a saving of 80 per cent of the fuel bill, to say nothing of the reduced wages due to the elimination of the firemen.

The engines of the vessels are of a new and simplified design. In starting, by a simple movement of a hand lever the engine is turned by compressed air, just as the automobile engine is turned by its electric starter, until self ignition begins in the cylinders. It should be noted that the boat was brought from the builder's yard to deep water in Delaware Bay, through the shallow and tortuous channels of Missapillion Creek, under its own power—a trip which called for six days of almost constant maneuvering with the main engine. Reaching the open sea, the vessel was navigated satisfactorily in mid winter on a continuous trip from the Delaware Capes to Sandy Hook.

Left: New lighter "Worthington," first to be driven and operated by Diesel engines. Horsepower, 300. *Center:* Electric motor-operated hoisting engine which controls all derrick operations. *Right:* Starboard side of engine showing control assembly. All operations controlled from this point

A lighter that is driven by a Diesel engine

Glass That Is Opaque to the Ultra-Violet

RECOGNITION is being given these days to the invisible portion of the spectrum, which is known to exceed greatly in range the section to which the human eye is sensitive. Indeed, the ultra-violet and in less degree the infra-red waves partake of most of the characteristics of light, and are distinguished from it, if properly at all, by the mere accidental fact that our eyes are so built as to receive sensible impressions only from a short region toward the middle of the spectrum, from red to violet. Photographs can be taken with the ultra-violet rays, the light of the mercury-vapor lamp is extremely rich in them, and they have a powerful effect upon living cells. Certain animalculæ which will survive exposure to violet light for four or five hours are killed by the ultra violet within fifteen seconds. The effect of these rays on the human skin, eye, etc., is different only in degree and in no sense in kind.

It therefore becomes an object to screen off these rays from ordinary light, if this can be done. The familiar fact that glass of appropriate color can be found to screen off any desired portion of the visible spectrum leads hope that substances may exist transparent to the visible wave-lengths but opaque to the ultra-violet. This hope is realized in a substance which is now being marketed in England after extensive tests by numerous prominent scientists. It is anticipated that this substance will play a very important part in the future development of the optical industry and particularly of cinematography, as by its use the ultra-violet rays are absorbed and at the same time there is no interference with the natural and useful light rays. It is a well known fact that in cinematography the light employed either in taking the film or its subsequent display, contains an abnormal amount of ultra-violet light, and both for the artist and the spectator a good deal of injurious mischief is caused to the eyes. By actual tests that have already been made and demonstrated in studios and in cinema theaters, with the new glass, it has immediately been noticed that through the absorption of the ultra violet rays the eye strain and fatigue has been considerably lessened, and, in many instances, a complete restful effect has been noticed.

As indicating the performance of this glass, the result of a specific test is given. A sheet of the glass 2.24 millimeters in thickness was employed, and in the interval between 0.000,036 and 0.000,03875 meter, 28 determinations were made, at approximately equal wave-length intervals. This section of the spectrum corresponds roughly with the dividing line between visible and invisible, though of course no exact line of demarcation can be drawn, since individual capacity for perceiving the extreme violet end varies. For the shortest waves in this interval transmission was about 3 per cent, for the longest, about 86 per cent, and the variation between the two readings cited was approximately uniform.

Windproof Plate Glass Windows

NEW YORK and other large cities have had abundant experience going to show that the force of the wind is extraordinarily increased as it swirls about sharp corners and through narrow streets, and that no ordinary plate-glass window is safe against breakage in heavy storm. The trouble with the modern shop window lies in its size. A bridge of glass 12 feet or more in height and 20 or 30 feet between moorings has to support as a bridge the actual pressure of the wind, and, in addition, it has to withstand the shattering tendency of the vibration which the erratic gusts set up in the sheet itself. To meet the latter condition, which is regarded as the more serious of the two causes of breakage, is the object of the simple little attachment which we illustrate. This consists merely of several arms of metal which project down from above, curl forward toward the window and bear upon it with surfaces of felt fastened over their metal ends. This effectually checks vibration and greatly reduces the probability of the window's finding the weather too severe for it.

Logs of Plaster for the Motion Pictures

By Frank B. Howe

THE seemingly paradoxical industry of making logs out of plaster is the latest innovation in commercial enterprises. Undertaken because a motion picture company required a quantity of logs for use in a picture, and conditions of distance and rough freight handling prevented the use of the reality, a complete success has been made of the plaster-log industry, which was invented to fit the occasion.

The making of logs from plaster is the invention of the Louis B. Mayer studios in Los Angeles. A rough chicken-wire frame is first constructed and coarse mortar worked around this in the general shape of the log. When this is dry, a fine plaster is applied to the exterior by hand, the final shape of the log being fashioned at the same time. When this is dry, a special paint is applied over the whole thing. A second darker coat is applied where the supposed bark is to come.

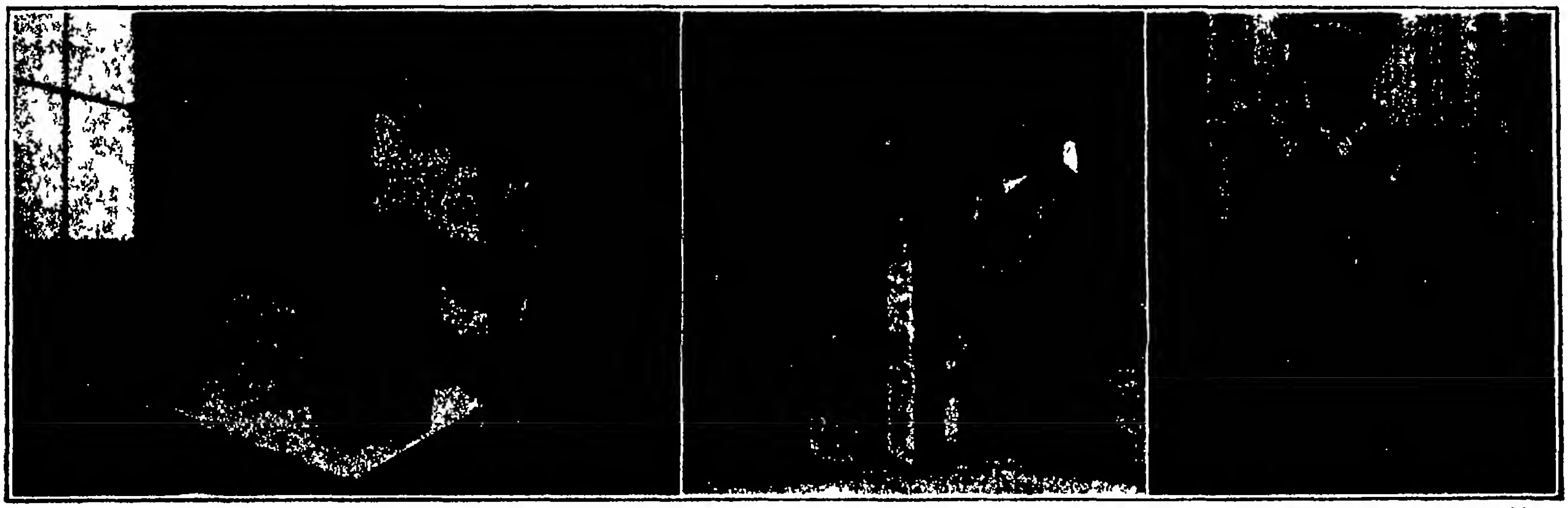
This done, the intricate part of the work is reached. With a sharp knife the cracks of the log are cut into the soft plaster exterior by hand. The log is then given a final coat of paint, and it is impossible to tell the plaster log from a real one by observation.

The unique industry has attracted much attention and interest in southern California, and the requirements of the various motion picture producers for logs of one sort or another insures a steady market for the product. Instead of having to import his logs from Oregon—a thousand miles away—with extreme care in handling so that the delicate bark will not be marred, the director can phone today for so many plaster logs and have them delivered the second day after.

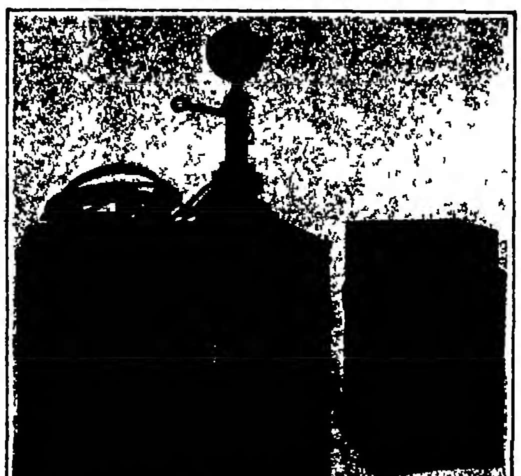
Improvement in Quality of Rare Metal Thermocouples

TESTS made by the pyrometry laboratory of the Bureau of Standards early in 1921 revealed the fact that many of the platinum-rhodium thermocouples found on the American market were subject to large changes in indication after long-continued exposure to very high temperatures. The wires from which these thermocouples were made were obtained from two sources, one American and one British. The tests showed that the former satisfactorily met all industrial requirements as to constancy and reliability if properly protected by well-known methods of insulation. The British refined metals and alloys were found to be subject to large changes in their indications because of exposure to high temperatures. Chemical and spectroscopic tests revealed the fact that the trouble was due to the presence of several tenths of a percent of iron in the platinum-rhodium alloy wire. The platinum wires, on the other hand, were found to be of high and satisfactory degree of purity. The facts developed by these tests were immediately communicated to the firms engaged in refining the metals used for thermocouples as well as to manufacturers of pyrometers who were employing them in their pyrometric installations. As a result of these tests, the British firm has located the seat of the difficulty, and is now marketing thermocouples that are satisfactory in all respects.

The little protector, in place, that prevents vibration and resultant shattering of plate glass in high winds



Three stages in the manufacture of plaster logs, a trade to which the motion picture studio has given birth. Logs of plaster are cheaper than the real thing brought a thousand miles from Oregon



The superphone for wired wireless conversation

A New Telephone Invention

A DEMONSTRATION was given recently in the office of the Chief Signal Officer of the United States Army of a new telephone invention, the "Superphone," which has been developed under the direction of R. D. Duncan, Jr., chief engineer of the Signal Corps Research Laboratory, at the Bureau of Standards, assisted by S. Isler, assistant radio engineer.

The new device is based on the original invention, about 10 years ago, by Major General George O. Squier, Chief Signal Officer of the Army, of "wired wireless" or "line radio." It consists of a small portable set of instruments which may be installed in any office or residence in a few minutes and connected directly to existing telephone lines, and conversations carried on in the usual way. It will be necessary only for the subscribers to close a switch or press a button to connect in the superphone in place of the ordinary phone.

This superphone provides a means for secrecy of communication without any chance of the conversation being overheard, interrupted or broken into on the line by any one else. It is obvious that this invention will prove of value for military purposes in case of war, where secrecy in communication is absolutely necessary. It may also prove of utility for ordinary commercial purposes where important business houses, such as banks, brokers, etc. may desire to have private channels for confidential communication with their branch offices or with any business establishment, and insure secrecy of the conversations carried on.

The principles involved in this invention are those of "wired wireless" by which high frequency alternating currents are employed which are modulated at the transmitting end by speaking into an ordinary microphone and detected at the other end by the usual radio instrumentalities which finally pass on to an ordinary telephone receiver. The speaker however, or the listener in is not concerned with any of the additional instruments they are installed and properly adjusted once for all and the people carrying on the conversation have no more bother than in the use of the usual telephone system.

Another advantage of this method of telephone communication is that it makes multiplex telephony possible. A number of secret telephone conversations may be carried on simultaneously over the same line without interfering with each other.

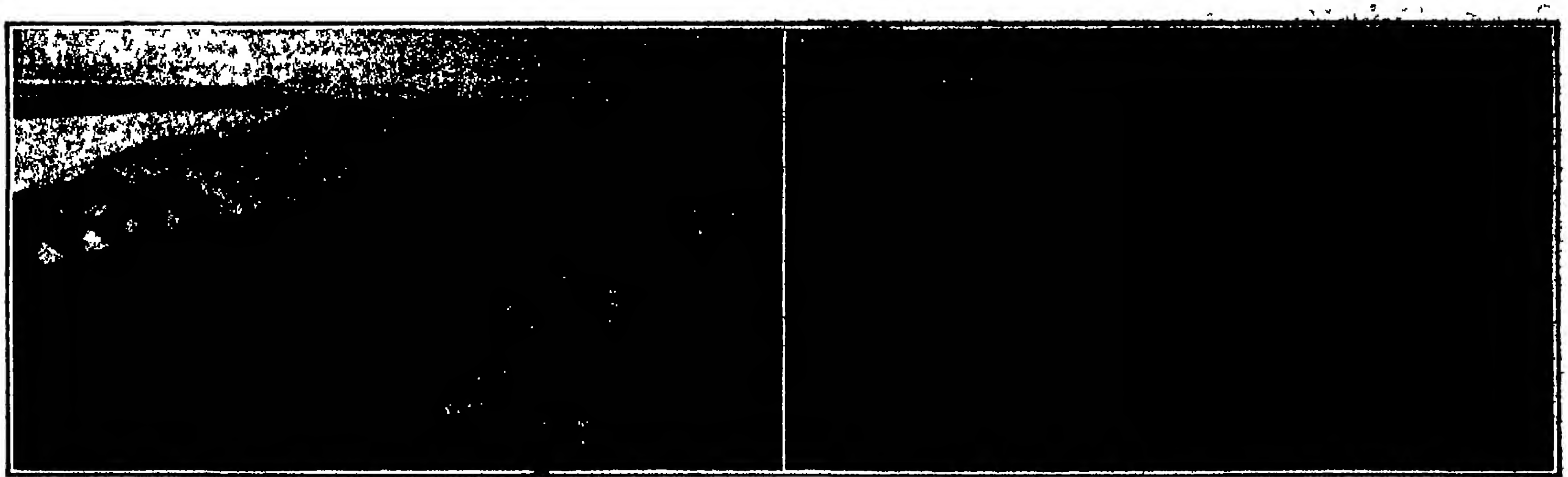
The transmission of speech by the utilization of this invention is even clearer than ordinary telephonic speech.

The power required for carrying on conversations over even considerable distances is of the order of one-tenth of a watt which is about 1/500th of the power required to light an ordinary electric lamp.

Severn Tunnel Ventilation

NEW ventilating plant is being provided by the Great Western Railway for the Severn Tunnel, England, the increase of traffic necessitating an installation of greater power.

The new fan will be 27 feet in diameter and 9 feet wide, and working normally at 100 r.p.m. will supply about 800,000 cubic feet of air per minute. It will be driven by a horizontal tandem compound condensing engine of about 800 indicated horsepower, having cylinders 21 inches and 42 inches in diameter with a stroke of 30 inches.



Left. Stern view of 23-knot armored cruiser "Lancaster" of 9800 tons. *Right:* Part of the double bottom (all that is left) of the 25½-knot, 17,250-ton, battle cruiser, "Inflexible"

Reducing Dreadnoughts to Scrap Metal

What the British Have Done By Way of Disposing of Their Obsolete or Discarded Fighting Ships

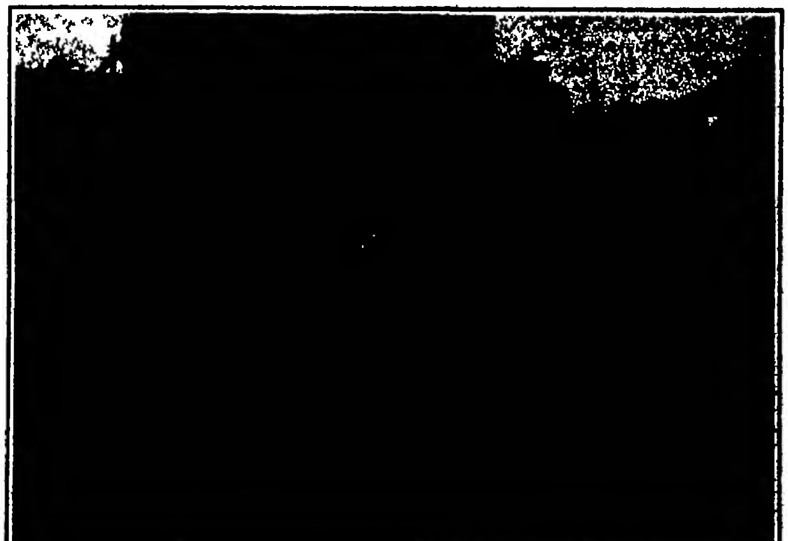
By Hector C. Bywater

ONE of the most difficult problems confronting the British Admiralty at the end of the war was how to dispose of the many hundreds of fighting ships that were no longer needed. With the dispersion of the Grand Fleet and the calling home of numerous squadrons which had been guarding the sea routes all over the world, every naval port became congested with redundant ships. Scores of battleships and cruisers, hundreds of destroyers and smaller fry, were left to rust at their moorings. Some had a few men on board to keep essential fittings in good condition, but the majority were deserted. These long lines of unwanted ships made a melancholy spectacle. Comparatively few were obsolete in point of age. Many had been launched during the war period, and had thus been in service only three or four years, but as they were in the official phrase, "surplus to post-war requirements," they simply had to be scrapped. Since they could not be left indefinitely at the naval dockyards, taking up valuable room and impeding traffic, there was nothing for it but to sell them as junk. Shipbreaking is quite an old-established industry in Great Britain, dating from the "wooden wall" era, when old line-of-battleships and frigates were demolished for the sake of their timber and metal fastenings, for which there was a good market. New methods had to be adopted when the wooden ships gave place to ironclads, the first of which came into the shipbreaker's hands during the 'eighties of last century. Business in this line was particularly brisk after 1906, following Lord Fisher's clean sweep of ineffective material from the Navy. But never before had scrapping assumed such dimensions as in the three years subsequent to the armistice. Some idea of the magnitude of the process was conveyed by an Admiralty announcement in May of last year that 113 warships—including 5 battleships, 12 cruisers, and 75 destroyers—had been sold in one block to a single firm, Thos. W. Ward, Ltd., of Sheffield. Of late, however, there has been a distinct falling off in the demand for obsolete ships. Not only have British shipbreaking firms bought all that they can deal with for some years to come, but the depressed state of the iron and steel trade has reacted on the scrap-metal market, making it difficult for these firms to continue their breaking-up operations on a profitable basis. In these circumstances the Admiralty has had to sell ships abroad. Many have gone to Germany, where scrap steel is badly wanted, and down to the end of January nearly 200 000 tons of obsolete British war vessels had been purchased by German firms. Thus, by the irony of fate, the British Navy is contributing directly to the restoration of German trade. With the entry into force of the Washington naval agreement which calls for the immediate scrapping of 20 British capital ships, a considerable addition will be made to the surplus naval tonnage now awaiting disposal. Most probably, however, the ships in question will merely be disarmed and otherwise dismantled in accordance with the rules laid down in the Treaty, and then put aside for breaking up at a more convenient time.

So far as the British shipbreaking industry is concerned, the methods in vogue are comparatively simple, and much the same whether the job in hand is the wrecking of a dreadnought or a destroyer. Briefly, the procedure is as follows. As a general rule the naval authorities remove all guns, mountings, and ordnance equipment, together with confidential instruments and fittings, before the ship is handed over, though in some cases only the light equipment is taken out, the armament itself being left in place. The vessel is then towed away to the shipbreaking yard. This is a somewhat hazardous operation in the case of a battleship or other heavy vessel for the removal of so much weight has greatly reduced her draught, and in this light condition she is apt to become unmanageable if heavy weather is encountered. It is quite a common occurrence to hear that a vessel has foundered or gone ashore while on the way to be broken up. Nowadays, practically all shipbreaking in Great Britain is done on an open foreshore, docks being but seldom taken for the purpose, as their use entails heavy expense and much inconvenience. The arrival of a doomed ship is timed to coincide with a high tide, on the crest of which she is floated as far in as possible, to be left stranded well up the beach as the waters recede. She is then invaded by an army of wreckers, who strip the decks clear of all obstructions. Masts, funnels, bridges, deckhouse, superstructure, and gun turrets are the first to go, and in a surprisingly brief space of time there remains only the bare hull. Years ago it was customary to use explosives for breaking up the decks and wrenching apart the stout scantlings, but this method is no longer in favor. Dynamite has been superseded by the all-conquering oxy-acetylene torch, which cuts through stout plating like a knife through cheese. Gangs of torch operators swarm over the hull, cutting it down deck by deck until they reach the boilers and machinery. In small vessels these are lifted out intact, in the larger types the engines have to be broken or taken apart in the ship before they can be lifted out. When the hull has been rased as far as the double bottom, it is hauled up on to a framework known as a "grid," in which position the keel plating can be attacked and the job finally completed.

When a ship is fitted with side armor the plates are unbolted and lifted out bodily, to be dealt with on the wharf or in the wrecking shed nearby. Ordinary deck and shell plating is burned out in sections just small enough to be handled by the crane. These are then deposited on the wharf, to be cut up into portable sizes by the torch or mechanical shears. In some Continental shipbreaking yards the entire hull of the ship is cut up into small sections in the first instance, so that the junk can be loaded direct from the ship into railroad trucks or barges, as the case may be, for conveyance to the furnaces. This method is probably more economical in the long run than removing large sections which have to be cut up a second time before they can be transported in pieces small enough to pass through the furnace door, but, of course, it lengthens the wrecking process very considerably. Massive machinery and heavy castings removed from the ship are broken up ashore by the so-called "putt" or "skull-cracker." This is a primitive but effective device, consisting of an iron ball, weighing anything up to two tons, which is hoisted aloft by the crane to a height of 60 or 70 feet, and then released by a trip catch. Crashing down with tremendous force, it splinters the hardest metal like glass, and a few blows of this Cyclopean hammer will pulverise the stoutest casting. Few can watch the skull-cracker doing its worst on a magnificent set of marine engines, which but a few years since represented the highest example of engineering art, without meditating on the impermanence of human achievement; but it is consoling to reflect that all this fine material is not to be wasted. Smelted down and cast into new shapes it may serve some purpose even more immediately useful to mankind.

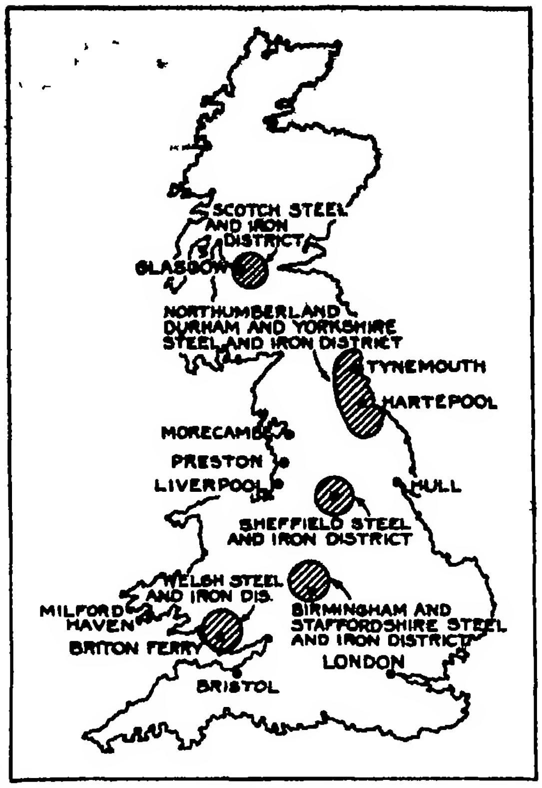
Through the combined efforts of the skull-cracker, the oxygen torch, and the shearing machine practically the whole of the material from a demolished ship is speedily reduced to mountains of scrap metal. To the uninitiated it may seem



Shell of the 2780-ton, 25-knot cruiser "Adventure." Beyond is the big ex-German flotilla leader, "Kaempferfelt," ready to be broken up

wanton extravagance to break up the boilers and machinery of a battleship, a cruiser, or a destroyer instead of converting it to some other use; but the truth is, of course, that naval propelling plant differs radically from that of merchant ships. Designed for high pressures and a correspondingly heavy fuel consumption, it would have to undergo considerable modification before it could be operated on an economical basis, and the cost of such alterations would be prohibitive. Thus a discarded set of man-of-war's engines is a white elephant, valueless except as junk. On the other hand, many articles of ship's gear and parts of the auxiliary machinery are taken out, furbished up, and sold as they stand. These include dynamos and motors, pumps of every description, boiler fittings, auxiliary steam, oil, and hydraulic engines, winches, ash hoists, condensers, distilling apparatus, refrigerators, tanks, ventilators, and a hundred and one items of marine equipment. Furniture and panelling, especially that from the officers' cabins and wardrooms, is also carefully removed and kept for sale. Pipes and cables are either sold as they are or reduced to junk. Previous to the introduction of the oxygen torch the destruction of big guns and armor plate was a tedious business, but now it presents no difficulty. Light and medium armor plate, *i. e.*, less than nine inches thick, can be cut up by a torch operator working on one surface only, but thicker plates have to be cut from both sides as the flame of the torch generally used in shipbreaking work will not penetrate deeper than nine inches. Guns of the heaviest caliber are easily cut up into sections. In pre-war times, when obsolete war craft were put up for sale only at infrequent intervals, shipbreaking was a less specialized trade than it has since become. With so much work in hand the firms concerned have found it expedient to employ new labor-saving devices, upon which, be it added, their workmen do not always look with favor.

A few words may be said about the purely commercial side of the undertaking. The service displacement of a warship must not be assumed as representing the weight of junk she will yield when broken up. When the naval authorities have taken out the guns, stores, ammunition, fuel, etc., the displacement is reduced by at least 25 per cent, so that a vessel nominally of 16,000 tons would be brought down to 12,000 tons before being handed over for demolition. Of this weight, steel would account for about 70 per cent, brass, copper, lead, and other metals for 15 to 20 per cent, leaving a 10 or 15 per cent residue of unmarketable waste. The value of metal junk is governed chiefly by the distance it has to be conveyed to the furnaces. Obviously it would not pay to break up a ship at some remote point on the coast, hundreds of miles removed from a smelting works, as the freight charges on the junk would absorb all the profits. In this respect British shipbuilders are fortunately situated, their yards being within easy distance of the great steel and iron manufacturing centers. There is, for example, a big yard at Briton Ferry, South Wales, and close at hand are some of the largest steel works in the country. Here, therefore, the cost of transport is a more or less negligible factor. It will be seen from the map that all the shipbreaking ports are conveniently near to important manufacturing districts. But, as before mentioned, business in the iron and steel trades is exceedingly slack just now, and for the time being shipbreaking has ceased to be a particularly lucrative proposition in Great Britain, even for those firms whose experience enables them to conduct it on the most economical lines.

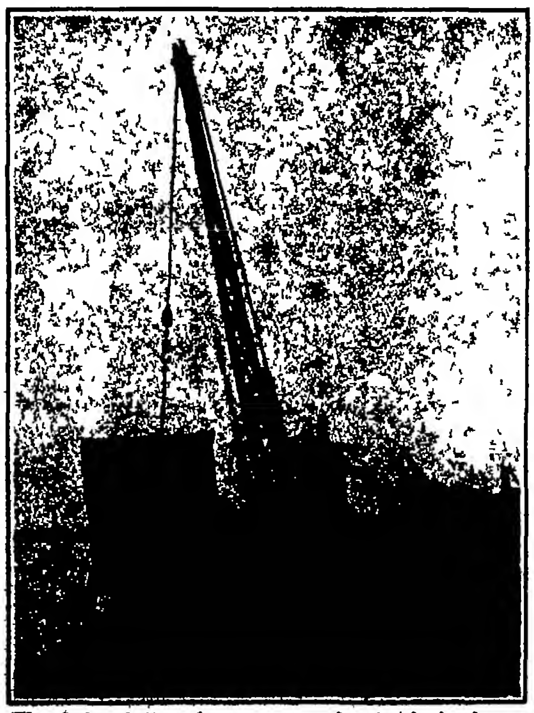


Map showing location on coast of ship-breaking yards and their distances from the various steel and iron districts of England

Salvarsan and Neosalvarsan

IT is well known that arsenic is a very deadly poison. Less generally known is the fact that it can be taken in certain quantities without any bad effects at all, and if these quantities are increased slowly, finally a dose of arsenic, sufficient to kill the ordinary individual, can be safely administered. In certain sections, mountaineers are accustomed to take arsenic regularly in large doses, for it enables them to climb steep hills rapidly without loss of breath. The unfortunate part about this practice is that, like the use of narcotic drugs, once it is started, it is very difficult to get rid of the habit. But arsenic besides being a poison is also a drug, for it has very destructive action on certain disease germs. This fact was known to the Chinese ages ago and is mentioned in the writings of Pliny. The difficulty with the use of arsenic was the very fact of its great toxicity, and until the beginning of the study of physiological chemistry and the application of chemistry to the cure of disease, the drug was used but very little. What had to be done was to combine arsenic in such a manner with other elements that while the effect of the drug on the human organism was reduced to the lowest possible limit, the toxic action of the drug on disease germs was still strong enough to destroy them effectively. It was seen early that the thing to do was to combine the metal with organic compounds, and Ehrlich, who is renowned as the discoverer of 606 (salvarsan) and 914 (neosalvarsan), worked along these lines until he had obtained the proper combination to give the wished-for results.

These products are very complicated organic compounds containing arsenic, and belong to the same class of substances as the azo dyes. The method of manufacture is very complex and difficult. Originally they were made only in Germany, but ever since the German supply was cut off, a few years ago, they have been manufactured successfully in this country as well as in England and France. A very good description of the standard way of manufacturing both salvarsan and neosalvarsan is given in the French journal *Chimie et Industrie*, 1921, 296.



The hull plating is cut away by torch in large sections, which are afterwards cut up to furnace size by shears. This crane is lifting ashore a section of the British destroyer "Ribble"

Theoretically salvarsan can be made from seven different raw materials, but the process which has received the most extensive commercial application starts with aniline. The process is essentially one of synthesis, building up a complex substance from a very simple beginning. As aniline is made from benzol, which is one of the simple substances derived from the distillation of coal tar, salvarsan is what is generally known as a coal tar drug.

In the manufacturing process, there is produced an intermediate substance known as atoxyl. This product is of interest in that it was used with success in counteracting the germ causing sleeping sickness. Originally, an arsenic compound was used for this purpose, which was known as an *arsenilide*, and very often, when this drug was administered, it not only killed the disease germ but the patient as well. Atoxyl was found to be just as effective in destroying the germ as the arsenilide, but its toxicity was only one-fortieth of that of the latter.

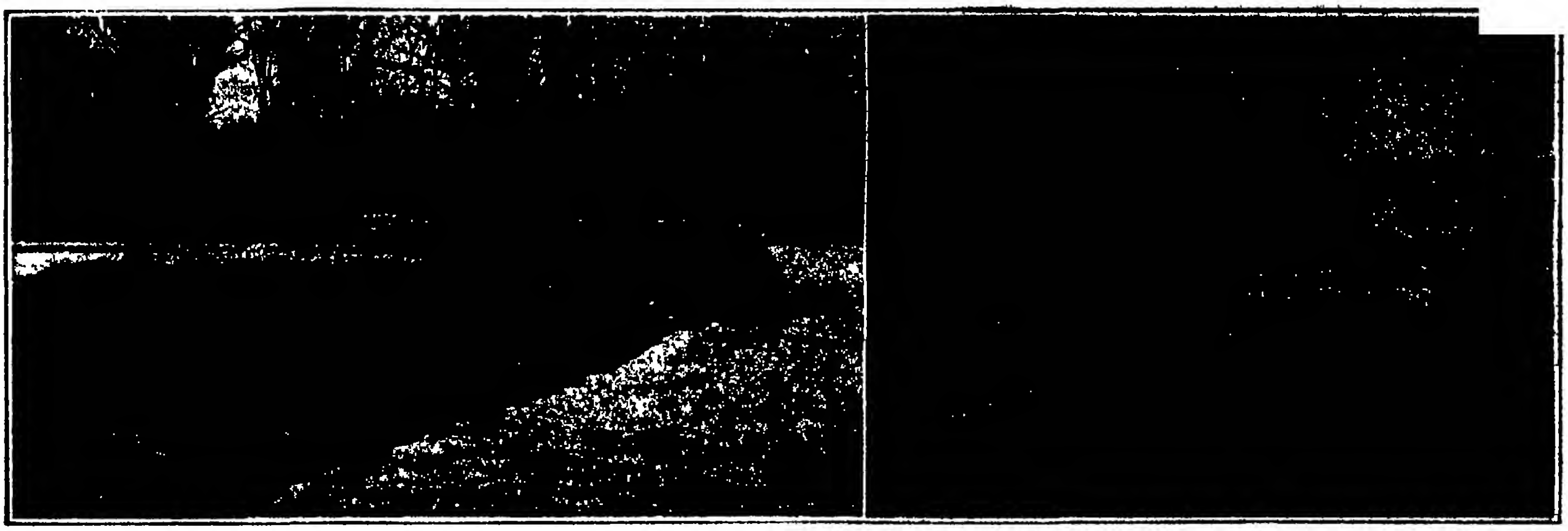
To obtain 606, atoxyl is treated further. The process in this stage becomes exceedingly difficult to carry out and only the very greatest care will yield the proper quality of salvarsan. The principal thing that must be avoided is the oxidation of the product, as then there is produced a substance which is extremely poisonous and the drug must not contain more than a few hundredths of a percent of this product. Salvarsan is a yellow crystalline powder, and due to its property of oxidizing in the air and forming the above-mentioned toxic derivative, it has to be packed with very great care, and the package in which it comes must not be opened except at the moment of use. The powder is placed in glass ampules or vials from which the air is carefully exhausted. Then the vials are sealed by melting the glass and the tubes are examined by placing them in water. If there is any pinhole opening in the seal, water will be sucked into the vial. Every vial must be perfect.

The uses of salvarsan are in the treatment of certain microbic diseases, such as recurrent fever, syphilis, sleeping sickness. Recently it has been used in the treatment of tuberculosis. The method of administering is by intramuscular injections, which are very painful. The solution of salvarsan is made in distilled water, which must be freshly prepared. The average dose is about 0.3 of a gram in 100 cubic centimeters of water.

In the early use of salvarsan, there were reported many cases of poisoning of the patients, due to the fact that in spite of all the care that was taken in its manufacture, the drug oxidized and formed the extremely toxic arsenious products. To avoid such happenings experiments were undertaken to see whether it was possible to produce a substance which would not have this dangerous property. The result was neosalvarsan or 914. This is made from salvarsan. The product is bright yellow and contains about 20 per cent of arsenic. It is packed in the same way as salvarsan, but it will not oxidize and can be administered without endangering the life of the patient. In addition to these products there is another preparation known as 1495, which resembles salvarsan very much and which is used to some extent. It is claimed that the injection of this drug does not give the intense pain caused by salvarsan or neosalvarsan injections. Some idea of the industry necessary for investigations of this character may be gleaned from the fact that the numbers attached to the three marketable commodities obtained represent their positions in the series of compounds with which Ehrlich has experimented, and presumably with which he is still experimenting, in his search for the perfect arsenic drug.

Sensitizing Solutions

THE dyes which are used in color sensitizing ordinary (blue sensitive) plates by bathing require different methods for their most successful application. Pinaverdol, pinachrome, orthochrome T and homocol may be used in water solutions, with or without ammonia, and are very little sensitive to electrolytes. Pinacyanol may be used in a water solution provided the plates are first thoroughly washed but gives greater sensitizing action with more fog and poorer keeping quality when used with water, alcohol and ammonia. Dicyanin gives comparatively little sensitizing except when used with water and alcohol and a fairly large per cent of ammonia. Commercial panchromatic plates have their color sensitiveness increased by washing in water without having the increase in fog which occurs when they are treated with ammonia. Scientific Papers of the Bureau of Standards, No. 422, entitled, "Color Sensitive Photographic Plates and Methods of Sensitizing by Bathing" covers this ground and is now ready for distribution. Anyone interested may obtain a copy by addressing a request to the Bureau until the free stock is exhausted.



Left: Willow mat awaiting the placing of rock to sink it. *Right:* Putting down the pine cradle to prevent erosion of soil

How rock and timber were combined with sand to build a road through the bed of a lake

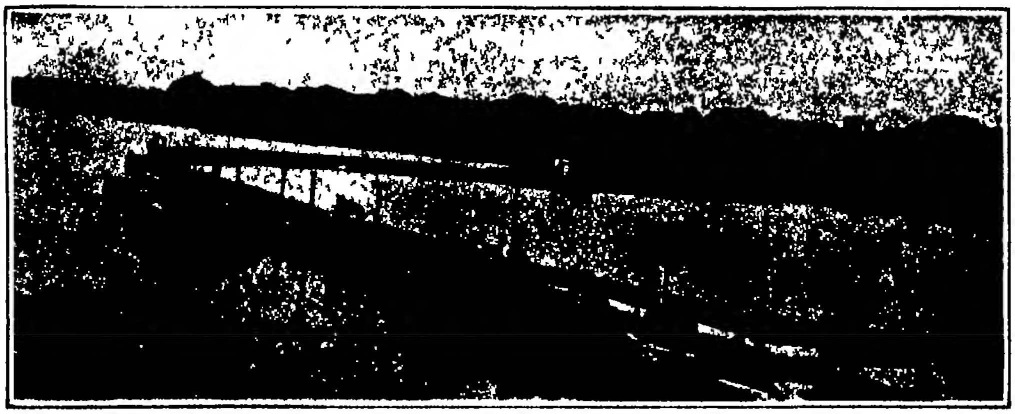
Building a Road With a Dredge

Sand, Pumped from the Mississippi River, Carries the Highway Across a Wisconsin Lake

By L. J. Jellison

A UNIQUE feat—that of constructing a sand road through a lake—has been completed by Wisconsin State Highway engineers at Sunfish Lake, through Grant county in Wisconsin. The lake road 82 feet above high-water stage, to prevent spring Mississippi river floods from interfering with traffic between Iowa and Wisconsin, was built on a relocation to obviate two bad curves that have taken toll of many lives. The road is a mile and a quarter in length

The principal feature of the construction is the fact that over 100,000 cubic yards of sand were necessary to fill the lake and give a 40-foot wide road, with 150-foot base Rock was secured from a quarry at the end of the fill, while willows used to riprap the sides were secured from an area of half a mile from the work



Pumping sand from the river channel to form a fill across the lake

Water, sand, willow and rock entered into the construction of the spillway as the road is called A broad expanse of bottom land with a 50-acre lake confronted engineers when they arrived on the scene Dredges anchored in the river sloughs off the main channel of the Mississippi river, began pumping as soon as the road location through the lake was determined upon.

Eight weeks of pumping continuously through 24 hour shifts was necessary for the sand fill Working from the river, lengths of pipe were added from time to time to the discharge lines as the level of the sand being pumped from the river sloughs reached the height desired, until, stretching away in the distance, a sea of sand, the lake road was completed

Unless means were taken to check erosion the sand road as pumped from the dredges would be swept away during the first Mississippi river flood, when the stage reaches 21 feet from a normal 6-foot level Rock and willow entered as factors in the making of the road Save where certain portions are to bear the brunt of high water, only willows are used to check washes in the sand due to rains and high water Where water pounding is anticipated or current swings, riprapping, using willows covered with rock, is employed to protect the roadway from the water's action

Mats are made Several dozen willows are bound together and other similar bunches connected until a broad blanket of willow bound together is secured. These are placed at the water's edge and for a distance of approximately 24 feet toward the peak of the fill and beyond the estimated water stage reached.

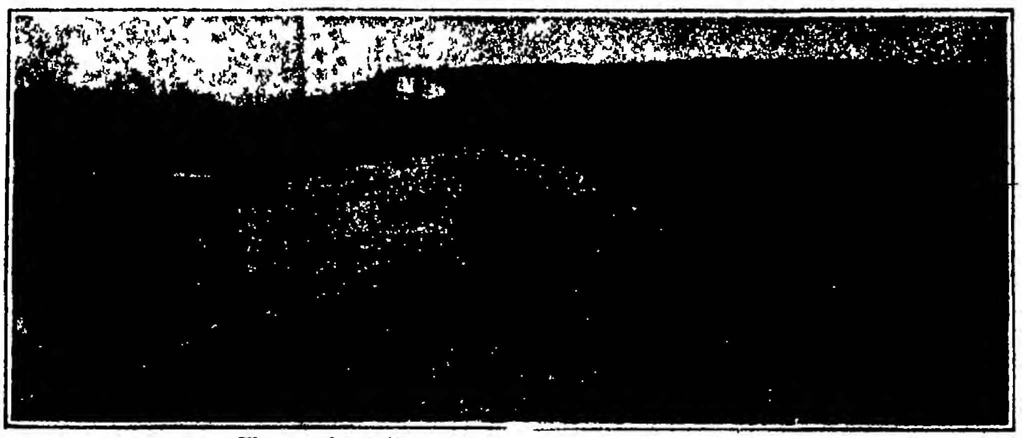
Where there is an undertow and in order to prevent a cave-in the procedure to protect that portion of the work is slightly different A broad mat of one-inch boards is made It is floated to the edge of the fill and anchored Willow bunches similar in size to mats made are affixed with thickness varying according to the character of the work to the mat A covering of rock sufficient to sink the mat and hold it is placed.

Where wind currents are expected to lash high seas willow mats in place are covered with a coating of rock. The majority of these rocks weigh 10 pounds or more. Willows in mats are always placed with the thicker end facing into the current The back wash binds sediment into the tops and brush of the lighter ends and furnishes in time a solid wall of mud and sediment making the riprapping indestructible

The road at the point where the sand fill was made consists of a sand core with blanketed sides of willow and rock depending on the amount of water wash For surfacing the sand core, a preliminary coat of earth mixed with rock is used Gravel and asphalt, or cement, depending on surfacing plans, is used for a finishing coat. Roads of this character are usually equipped with guard rails, cedar posts imbedded along the edge of the fill, and showing the danger line beyond which it is unsafe for vehicles to venture.

The Light of the Night Sky

PROF CHARLES FABRY, in a recent issue of *Scientia*, discusses the luminosity of the night sky He asks whether or not this luminosity can be attributed to an unresolved background of faint stars. In this connection he insists on the importance of concentrating attention on some small selected area and determining how many stars of each magnitude are present, with a view of extrapolation to stars below the 20th magnitude, which cannot be detected by existing telescopes. The luminosity of the general background of this area should be observed concurrently If, as appears probable, we cannot plausibly attribute the general illumination to unresolved stars, it would be natural to fall back on the hypothesis of scattered light. That the light can be due to scattering by gaseous matter appears improbable in view of Lord Rayleigh's recent observations on the color and state of polarization of the light of the night sky The article concludes by reference to the aurora as contributing in some cases to the light of the night sky.



The completed fill, ready for rock and willow riprapping

Why Did the Hermit-Crab Become a Hermit?

A Chapter from the Story of the Struggle for Existence That Accounts for This Curious Creature

By William Crowder

Male and female hermit-crabs. The little female, perched on the shell of the larger male, is his constant companion during the mating season

TO know the hermit crabs is to know the really engaging animals of our shores. Their comical antics, their brawls and everlasting search for trouble, would mark them at once as creatures of no mean individuality And how carefree an existence they lead! It is true they have some enemies which occasionally disturb the happy tenor of their lives, but for the most part their time is given over to a riotous round of pleasure—and pleasure to a hermit crab means feasting, lovemaking, and above all, fighting.

Yet they are deserving of sympathy They have other distinctions besides the foregoing which claim our consideration. For in the story of their lives is entailed one of the most extraordinary revelations to be found in nature The tragic details will never fully be known, but from the few fragments that are now decipherable there is indicated a history of an ancient struggle for existence, than which that of the rise and fall of an empire is not more impressive

I will incidentally observe in passing that the present writing owes its inspiration to *Pagurus longicarpus*. What is true of the little hermit of our own coasts may, in a larger sense, be taken as typical of the entire group.

The most outstanding feature of the hermit crabs is undoubtedly their curious habit of living in the shells of dead mollusks. This habit has been confirmed for a very good reason If we remove from its shell a full grown individual—the male, by the way, is larger than the female, and is about two inches long and of the thickness of a lead pencil—we find that, unlike the foreparts, which are armed with a thick, horny crust, the abdomen is very soft and invested with a delicate membrane. *The slightest rupture or abrasion to this abdominal covering is almost certain to be fatal.*

This region is unsegmented, differing from the ringed belly of the lobster and other higher crustacea, and tapers spirally toward the tail, which latter is an aborted caudal fan. It is here that the digestive tract ends. Two other appendages are on the left side a glance at their location and malformed appearance leaves no doubt as to their origin They are the vestiges of what, in the ancestral form of the animal, were once highly specialized locomotor organs. These feeble bristle-fringed outgrowths, however now serve an entirely different purpose than formerly on the male their chief use is for sweeping forward the stercoracious matter deposited in the shell on the female they have an additional function as anchorages for her eggs. Briefly, the belly functions mainly as an organ of prehension wherewith the animal maintains a hold on its portable home

It is apparent that the hermit crab is obliged not only to utilize a defensive covering, but when exchanging shells it must act with the utmost caution and dispatch lest it be harmed by some enemy who may be lurking near This exchange is often made at the mere whim of the animal, but there are several periods in its life when a new home becomes absolutely necessary This is after each molt, the consequent increase in size forcing him into larger quarters.

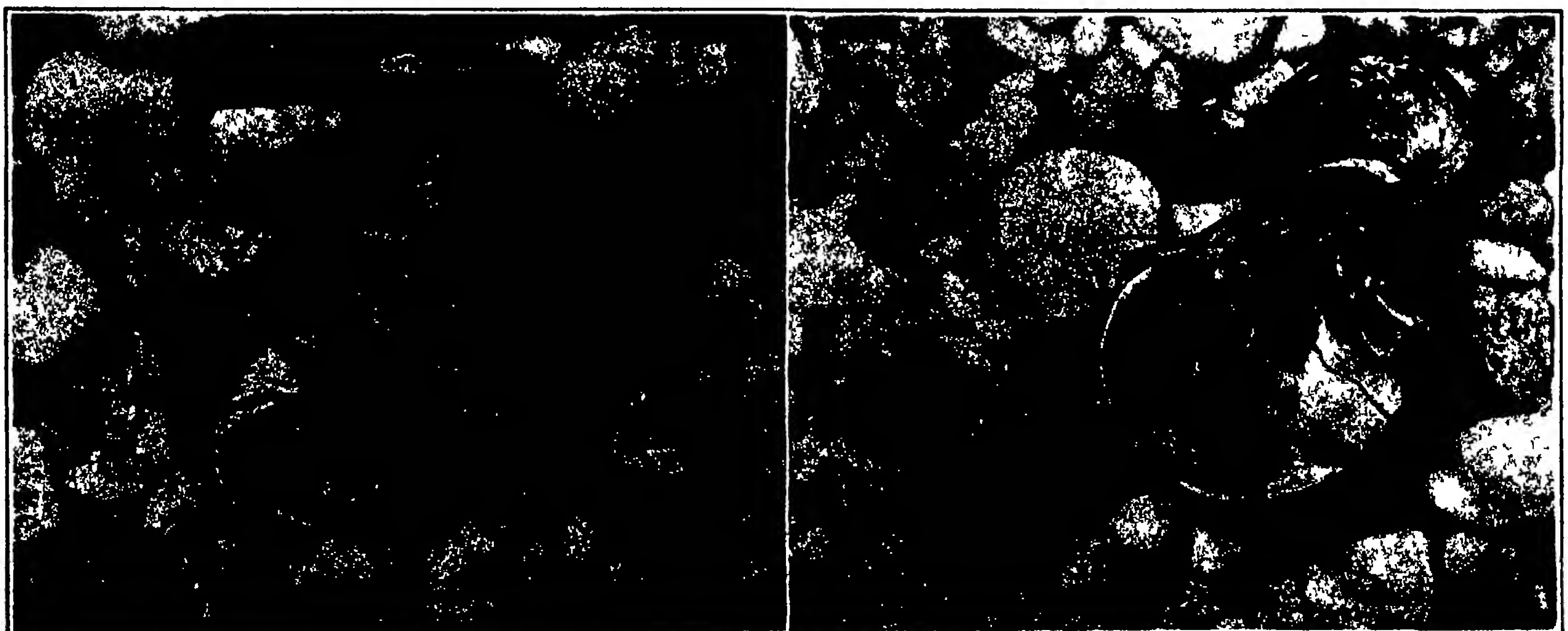
The hermit crabs are notorious fighters. Yet in the hundred encounters I have witnessed between them, in not one have I ever seen a serious bodily injury resulting therefrom But curiously enough the inevitable result of every combat is the loss of a shell by one of the antagonists. I can not visualize this better for the reader than by abstracting from my notes my first observation of this interesting sight Although this record was made some time ago, I could not add to it if I would So I transcribe it here without change, just as it was written at that beautiful tide-pool not far removed from the present writing in Glen Cove. I had just been watching a large male busily devouring a portion of dead fish, which he ate by pulling off small pieces with his great claw and bringing them to his mouth. While he was thus engaged a strange hermit crab, evidently attracted by the feast, appeared on the scene. The newcomer, also a male, was of an unusual size, his shell was covered with a downy growth—a colony of zoophytes—which made him look like a giant clad in furs. Then

"Each catches sight of the other at the same instant. A momentary pause ensues. Then with their great claws extended each rushes for the other furiously

Hermit-crab removed from its shell, showing the soft and vulnerable hind-body which requires a borrowed armor for its protection

The clash and rattle of their shells can be heard distinctly through the shallow waters as they come to a close, wildly seeking an advantageous hold Jabbing cuffing wrestling they display an astonishing agility, encumbered as they are with their heavy shells the rapidity of their movements seems almost incredible One is now uppermost, now the other Suddenly they part and encircle one another with a sidewise movement Again they come together But something happens. The newcomer, betraying a craven spirit wrests himself away and precipitately leaves the field by a backward run His retreat, however, is obstructed by a small rock, and the impact sends him topsy turvy causing him quickly to withdraw completely into his shell and block the opening with his claws In a trice the other is upon him Seizing one of the exposed hands he attempts to dislodge the coward by tugging so violently that the collision of their shells beats a tattoo The persistent attack apparently arouses a spark of resentment in the larger, for he emerges sufficiently to flourish a threatening pincer This is his undoing He is immediately grasped by a leg, jerked clear of his shell, and tossed over the victor's shoulder The latter, then grasping the rim of the empty shell vaults over into it and leisurely crawls away

The number of eggs in the spawning of a female hermit crab rarely exceeds 300—indeed, the number is often far less. They are deep cherry red and no larger than the period which ends this sentence Each one is suspended in a membraneous sack which in turn is attached by a short thread like tissue to a bristle on one of the forementioned appendages. They are car



Left: Male hermit-crabs fighting; the aggressor is attempting to drive the other from his shell. *Right:* The victor moves into the shell from which he has driven the other crab; the defeated hermit hovers just out of reach of his conqueror's claws, waiting an opportunity to seek his own safety in the abandoned shell of the other

A battle of hermit-crabs, and the curious outcome

ried thus by the mother—who gives them no other attention than an occasional brushing to keep them free from particles of dirt—for a fortnight, when they are ready to hatch

In the meantime, however, some remarkable changes have been taking place. If under the dissecting microscope we tear open an egg which is but a day old the differentiation of its organization can be seen making its first appearance That mysterious transformation, due to those unfathomed forces which cause the cells to assume their predetermined arrangement, has just taken place Nearly a week later examination of one of the spherical units will show that the yolk comprises nearly half the bulk while the remainder of the egg content reveals the dim outlines of the nascent larva Each succeeding day the embryo is marked by a gradual but very definite change Finally the tiny animal acquires a segmented hindbody, a large tail fin, and a pair of unstalked eyes. A more dissimilar offspring from the crawling adult could hardly be imagined, for the muscular ringed belly and broad tail singularly adapt it at this stage to a roving life at any depth

The moment for hatching is always signalized some hours before by a restless activity on the part of the larvae and by their apparent efforts to burst the double envelopes which confine them Suddenly the walls of an egg will split lengthwise and a wriggling youngster emerges through the rent It has no time to linger as it is caught in the respiratory currents of the mother and sent hustling away A common impulse then seems to animate the brood and within a few hours the remainder of the children abandon forever the precincts of the maternal shell. The mother then detaches the swaddling clothes still adhering to her appendages, and soon following the departure of her young she sends bag and baggage flying after

Thenceforth each little hermit crab pursues its uncertain fortunes alone After a lapse of nearly two months —during which it molts not less than four times, each time increasing in size and acquiring a more adult like form—it settles to the bottom and finds a tiny shell.

Such is the manner in which the hermit crab is ushered into the world. A rapid survey of its future shows that before the winter gales have forced it into the deeper waters to pass a semi-dormant existence it has molted once more and has now attained the length of a quarter of an inch The following summer will find it considerably larger, provided it will have had plenty of food and by the end of the third year it will have arrived at sexual maturity; whereupon it will begin to take notice of its fellows, both male and female. From this time onward its brawlings and lovemakings will continue until the end of five years, when, realizing that the business of life is done, it crawls under some sheltering frond of seaweed and dies.

Now, if one accepts the evolutionists' theory that the embryological forms of an animal tend to recapitulate the evolution of the species there is more, then, than a mere hint in the foregoing that the hermit crab did not always require a shell for its protection. As the fossil remains of crustaceans have been so meager, there is now, of course, no certain means of determining the true appearance of the hermit crab's ancestor Nevertheless, some reliance may be placed in the data afforded by comparative anatomy when attempting to reconstruct the phylogeny of a species, and from these data it may reasonably be assumed that the ancient forbears of the hermit crab possessed a segmented abdomen equipped with specialized appendages for swimming. From this it follows as a corollary that it was a rover of the open sea. That it later frequented the floor of the ocean is very probable. The present habits of other higher crustaceans—such as the lobster and kindred types—point unerringly to this conclusion.

But why did the primitive non-shell-bearing hermit crab forsake the open reaches to become a dweller of the shore waters? The answer to this question admits only two possible inferences. It was forced to seek this habitat for reasons either of hunger or of safety I think the first mentioned may safely be dismissed as wanting in plausibility There is no good reason to believe that food material suitable for these animals did not always thrive in as great abundance in the outer regions as well as contiguous to the shores. In regard to the remaining factor, I will say at once that this latter seems to be the true and only cause. It was because of the appearance on the scene of a new and powerful enemy This enemy was the first vertebrate—the mailed fish For it must be remembered that until that time the crustaceans alone held dominion over the floor of the sea, and the greatest enemy of the crustaceans were themselves—the larger preying upon the smaller But with the advent of these new marine terrors came a change The extinction of the hermit crab was threatened. In fact, the actual disappearance of hundreds of groups, now long lost, was caused by their ruthless appetites.

The case then clears itself With the ever constant menace hovering over it for generations after generations, the hermit crab was driven to the shallower waters and into any place which afforded a shelter In the great abundance of shells in this neighborhood it found an admirable haven of refuge. Later it found it quite convenient to carry the shell with it, instead of venturing forth unprotected in search of food. And it was not until the disappearance of these monstrous enemies that certain of its shell-bearing kin wandered back into the deeper waters.

But this change to a fugitive life also brought a change in its diet, and ages of an abnormal adaptation have changed the structure and functions of its body From the predatory life of a rover and a freebooter it has descended to the life of a scavenger. Its belly, once an entity of strength, is now a feeble mass of pulp. In a word, the hermit crab is a degenerate.

Ashes and Sawdust the Basis of a New Industry

By C. M. Lewis

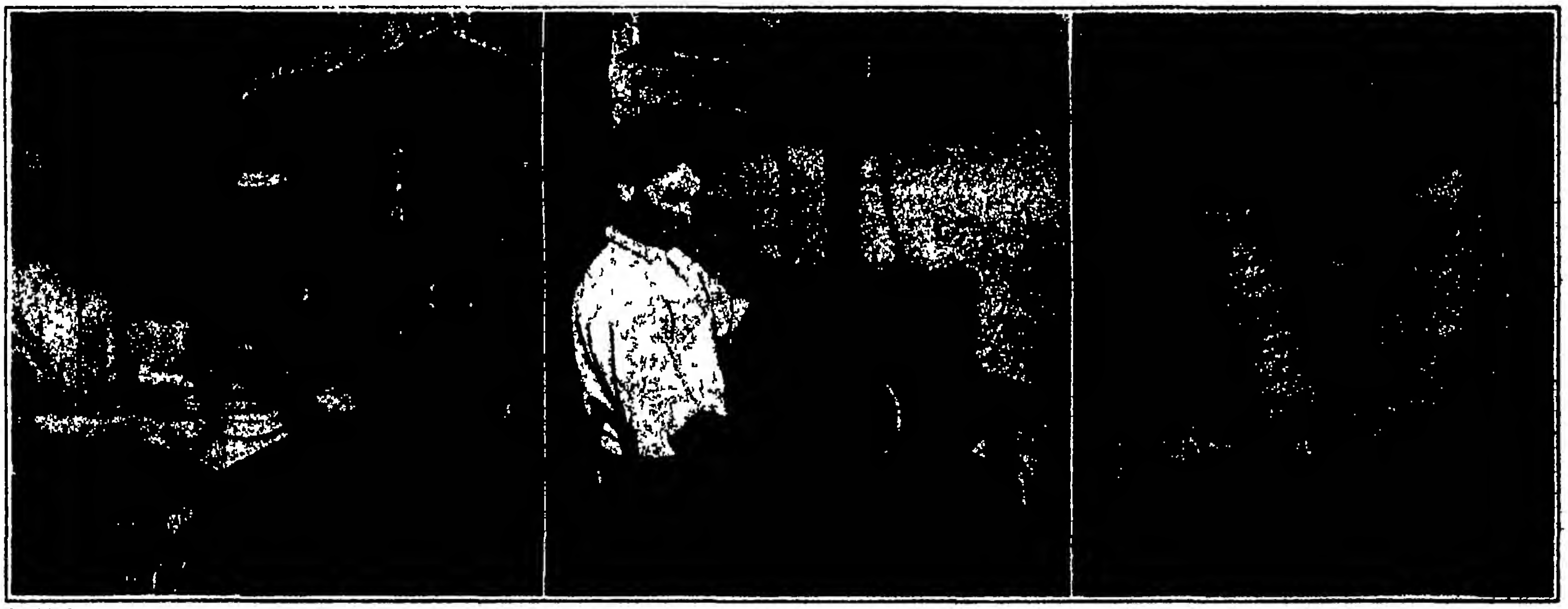
IN these days of large-scale production and large-scale waste in American industries, it has remained for Dr. Christian Jaeger to utilize two of our most easily obtained waste materials, sawdust and ashes, in a remarkable chemical composition which is a substitute for cardboard and wood. After long and patient study and experiment, covering a period of ten years, he has at last discovered a process which has opened up a new industry. When we consider that there are approximately ten thousand wood and cardboard box manufacturers in the United States, and that the annual output of the box trade runs into the millions, we must realize how important is this new composition, which is used largely in the production of boxes.

It is an interesting experience to watch the production of these boxes, really beautiful in design and finish, from the mixing room to the painting room, where the finishing touches are applied by skilled hands. Of course, the mixing room holds the secrets of the process. We know that ashes and sawdust—the ashes of any substance and the sawdust from any wood—are the two main ingredients of the composition. To these two constituents chemicals are added; the whole mixture is worked together thoroughly and rubbed by hand through a large sieve; and the resulting rather coarse, dry powder is then ready for the presses.

The operation of the presses is an important factor in the cheapness of the whole process. There are four presses in Dr. Jaeger's factory. Two of them are for the making of the bottom parts of the boxes, and two of them, by means of elaborately designed bronze dies, impress upon the covers of the boxes designs ancient or modern, Roman, Greek, Egyptian, Gothic, Moresque, or of the Renaissance period The powder from the mixing room is inserted in little boxes under the presses, the presses are lowered for a period of about three minutes, the powder bakes like bread, turns a delectable, creamy brown, gives off a pungent odor; the presses are lifted, and out come the boxes, complete in shape and design from a single operation. One of our photographs shows a close-up of a tray of boxes fresh from the presses. The rough edges are smoothed off on rotary emery wheels, then the boxes go to the painting room.

The discovery of a paint which could be applied to this composition was not made until after a good many fruitless experiments on the part of Dr Jaeger. At first, the paint refused to stick to the surface; it curled up and flaked off. At last, after about two years, Dr Jaeger produced a paint that could be applied smoothly and would give an even, glossy finish. The first coat of paint is applied by hand. One of the virtues of Dr. Jaeger's paint is its drying quality. No drying rooms are necessary, almost as soon as the first coat is applied the boxes are passed on to the workmen who handle the air brushes and finish them with delicate tints or with ivory, ebony, bronze, silver or gold effects.

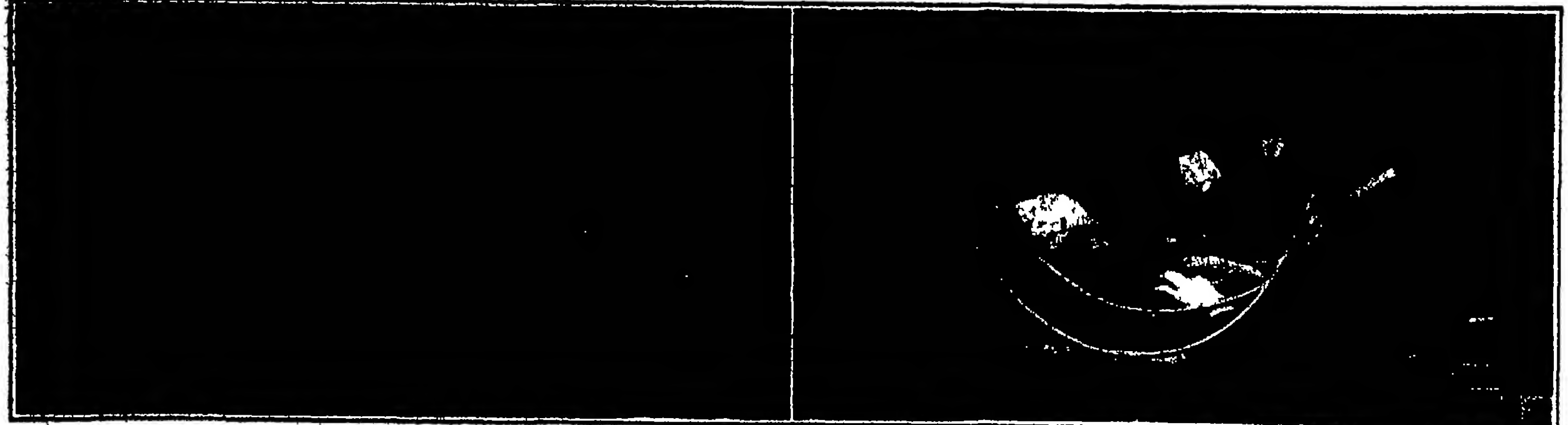
The finished boxes are light in weight, washable sanitary and non-poisonous. They are as fire-proof as asbestos, waterproof, and can be made of any degree of texture of flexibility, either as pliable as cardboard, as hard as oak, or as tough as metal. They are very cheap, a pound of the substance, from which about three boxes can be made, costs not more than five cents. Climatic changes will not affect them; they neither shrink nor expand. They can be plated in genuine bronze, silver or gold, or finished in the process with a surface of chemically prepared silk or satin, real or imitation plush or velvet.



Copyright, Keystone View Co.

Left: The finished box being taken out of the press. *Center:* All manner of fancy designs can be achieved in these boxes. *Right:* A row of finished boxes being sprayed

Making boxes from a chemical composition obtained from ashes and sawdust



Left: General view of the recording room in a French high-power radio station. In the foreground the operators are engaged in recording an incoming message by means of a disk phonograph. Behind these operators may be seen a special wire cage, which contains the receiving equipment and protects it against local parasitic disturbances. To the left may be seen two operators adjusting the photographic recorder and reading the photographic record tape. *Right:* Three operators transcribing the dots and dashes from the phonograph records. Each operator attends to one phonograph, and uses a noiseless typewriter

Capturing the elusive dots and dashes of radio on phonograph records and photograpic tape for subsequent transcription

Speeding Up Radio

New Methods Employed for the Automatic Reception of Radio Telegraph Dots and Dashes

By Francis P. Mann

Piece of photographic recorder tape containing part of a message received at the rate of 200 words per minute, with the transcribed message below each dot-dash character

THE capacity of radio telegraph stations is to be increased to a considerable extent in the near future by the use of rapid methods for receiving the messages. The efforts in this direction which have been made by one of the largest French radio companies are now meeting with great success. This firm has been very active in the construction of wireless stations, one of the most recent being the great station of La Doua, at Lyons, which is now working with the United States. This station has already been described in our columns, so that we will confine our present efforts to a brief account of the methods and apparatus which are employed for recording the messages at high speeds.

The phonograph method is employed for taking down messages at speeds which are considerably above the usual rates, this speed being in all cases above 25 words per minute and may reach as high as 100 to 150 words. But it is evident that messages with the dot and dash system cannot be read at such high speeds on the telephone by the operators of the station. The phonograph can, however, be called upon to take down the messages at these rates, and by means of the new apparatus the signals are now recorded upon the phonograph without difficulty. A phonograph of the customary disk type is employed for this purpose, making necessary certain slight changes in the equipment, such as are required to adapt it to radio service, all that is necessary being to mount the receiving telephone in the place of the usual phonograph recording diaphragm, the telephone diaphragm being provided with a stylus for producing the record on the disk.

It is found that the phonograph record is still quite satisfactory when the apparatus is working at 150 words per minute. When the disk has received the telegraph message, it is transferred to a second device which serves to reproduce the sounds in the usual manner, but the record type of phonograph is of a somewhat different design, and is designed to operate at slower speed in order to enable the operator to read the messages.

One of our illustrations shows in the foreground the high-speed phonographs which are employed to take down the messages, while in another view will be observed the slow-speed apparatus used for reproducing purposes only, with an operator for each phonograph taking down the messages on a noiseless typewriter as fast as he is able to write. In order that the sound shall not be of too low a pitch when running the phonograph at reduced speed for receiving the messages, the radio receiving apparatus is regulated, in case the system of continuous waves is employed, in such manner as to provide a high pitch for the original message, so that the pitch can afterwards be reduced without being too slow to carry out the receiving operations to good advantage.

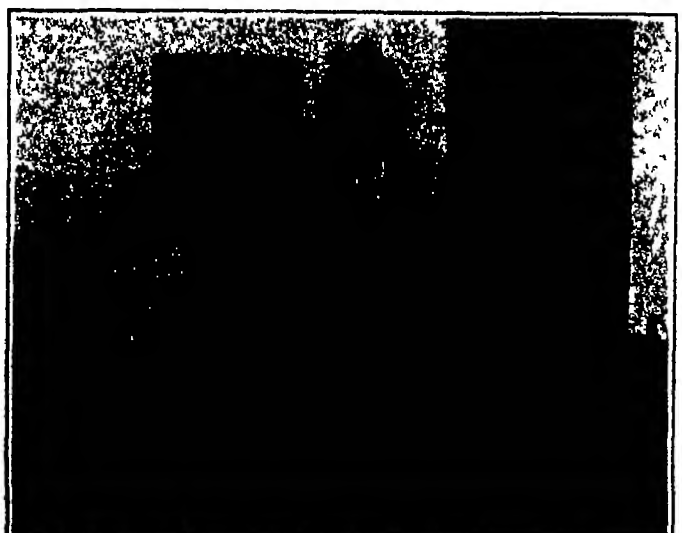
A still higher speed for recording wireless messages can be reached by making use of the photographic method, and by the use of improved apparatus recently brought out by the French firm it is possible to operate at speeds which can handle up to 500 words per minute. This makes it a more rapid means for receiving messages than the phonograph system, and the new photographic apparatus is not of an unduly complicated nature. Indeed, it is so designed that all the operations can be carried out in a very simple manner and by persons having no very special skill.

The photographic recorder is based on the use of a galvanometer containing a small mirror which is adapted to swing under the action of the radio impulses forming the signals, the current at the receiving end being amplified to the proper degree by the use of the usual amplifying devices. The duration and amount of the swing of the mirror will correspond to the dot and dash signals, while the mirror reflects a beam of light on to a strip of sensitive paper tape which is caused to unroll at a greater or less speed, according to circumstances. The beam of light thus traces the message on the strip. The result is that the message will appear in the form of dots and dashes, as shown in one of our illustrations, when the strip is developed by the usual photographic process. No difficulty is experienced in taking down messages at the rate of 500 words per minute. It should be remarked that such messages could not be read by a station which is not provided with the photographic receiving devices.

The new system will be valuable as affording a method of considerably increasing the capacity of radio stations, and the method is, in fact, comparable to automatic telegraphy. The developing, fixing, washing and drying of the photographic strip are carried out automatically by means of an improved device which performs all these operations within a very short time. It is now found possible to use the same photographic strip to receive messages sent out by two different stations at the same time, or by the same station sending two simultaneous messages (in fact, several messages can be sent) on the new multiplex system. In the present devices, two messages can be taken down at the same time and upon the same photographic strip. When the latter is completely finished, it can be read in the same way as an ordinary telegraph recorder tape.

The dot and dash signals are very sharp and clear, allowing the messages to be rapidly read off. It should be remarked that the dots and dashes being received can even be heard in the telephone receivers, even though they are too rapid to be read, but this at least affords a good means for adjusting the recording apparatus. The new devices have all the sensitiveness of laboratory instruments and at the same time are very simple and strong, being adapted for actual use in radio stations.

The photographic recording apparatus will be observed in the background of one of our illustrations, which shows the various devices in a French radio station.



Photographic recorder working at a speed of 200 words per minute. The operator, wearing the 'phones, hears the signals and can adjust the recorder accordingly

Lumber from Sugar-Cane Waste

Bagasse the Raw Material for a Product Designed Largely to Replace Wood and Relieve Our Forests

By Charles R. Ferrall

FOR twenty-five years many scientists have been working on the problem of finding some practical usage for bagasse, the cane fiber as it comes from the sugar mills after the juice has been extracted. It is produced in enormous quantities in the sugar-making sections. Professor C E. Monroe, inventor of smokeless powder, Washington, D C, has finally discovered a practical use for this material after spending a considerable period of time in experimentation

Dr Monroe s invention contemplates the use of this formerly waste material in the manufacture of a building board. When the question of the location of a manufacturing plant was given consideration it became obvious that New Orleans was the logical place It is estimated that there is enough sugar cane fiber available within a radius of fifty or sixty miles of the plant to make 200,000,000 square feet of new product annually The new plant is 1 000 feet long by 125 feet wide comprising a manufacturing building, power plant, engine room, boiler house a dryer building over 800 feet long, and a finishing building with necessary equipment such as storage and water tanks. From time to time additional units will be added as needed.

Some of the machinery in use in the new mill had to be invented especially for the particular purpose for which it is used in producing the product, as there was no machinery that could be used for the purpose in existence The plant began operation in a small way in August 1921 Small quantities of "celotex" were produced during the first days of operation in order to perfect the manufacture, to get the board uniform in thickness and of proper texture However, the experimental stage is past and the board which is being turned out at the present time is of high grade and uniform quality

The sugar cane fiber comes to the mill in 200-pound bales. These bales are opened and started through the process of manufacturing, eventually coming out in the form of a great board of insulating lumber This board, after it is properly cured, is sawed into proper dimensions by automatic saws. The product is waterproofed and boxes made of it have been known to contain water for a great many days without leaking

When the raw material is unloaded from the cars and started on its journey through the factory it is not touched by hand until it is delivered to the finishing room ready to be bundled and shipped. Sugar cane is practically the sole material used, the other materials required being merely the chemicals used in the mill process. In the process of manufacture the cane fiber is carried successively through breakers, soaking tanks, steam cookers, which thoroughly sterilize it, washers and on to the manufacturing machinery through the dryers and into the cutting-up saws by automatic machinery and devices

Celotex is made in thicknesses of one-half inch and one-quarter inch, and is cut into boards four feet wide by eight to twelve feet in length. The board is homogeneous—that is, it is not built up in layers but the cane fibers are so interlaced that they form a uniform stock throughout It is unique in this respect Other building boards are built up of layers of paper cemented or glued together The new product gets its perfect insulating qualities from the fact that it is filled with minute air cells formed by the interlacing of the fibers, together with the cells in the fiber and pith of the cane

One of the peculiarities of bagasse or sugar cane fiber is its indestructible quality It resists decay to such an extent that after lying in the fields for a long period of time it seems to be in as perfect condition as the day it was milled as far as any indications of decay are concerned. This is a very strong point in comparison with ordinary lumber.

Due to its high insulating qualities there is no doubt but that the new lumber will be largely used in the manufacture of refrigerators, fireless cookers and the walls of storage plants, and many other places where perfect insulation is required.

It is designed to take the place of lumber in every particular, such as for sheathing on the inside and outside of houses and paneling and for practically all other purposes for which lumber is used in building. It can be stuccoed and plaster will adhere perfectly to it. It is a good deadener in walls or under floors. It can be used under linoleum or oilcloth for flooring.

Celotex will stand the weather In fact, it is expected that it will be used extensively for weatherboarding and outside finishing in a great many buildings. Practical uses are being found for it every day in industry and no doubt it will be extensively employed in manufacturing merchandise Furniture manufacturers are already buying it in quantities to be used for veneer work, drawer bottoms and for many other uses in the furniture industry Even boat builders and ironing board manufacturers are investigating its use and are experimenting with it at the present time.

It weighs but six-tenths of a pound per square foot in one-half inch thickness, which makes it much lighter than any wood lumber It can be handled and sawed just like ordinary lumber Its color is a pleasing shade of tan and the surface is rough like burlap, although it is contemplated to sand or plane one side of it so that it will have a perfectly smooth finish

It has been shown as a result of tests, that building with this lumber will result in a saving of at least one-third of the fuel ordinarily used, due to its insulating qualities which prevent the passage of heat or cold.

The Comodoro Rivadavia Oil Fields

Argentina's Prospects of Entering the Group of Petroleum-Producing Nations

ARGENTINA, an agricultural and pastoral country par excellence, richly endowed by nature with an enormous wealth of raw materials capable of being manufactured into the finished goods demanded by its growing population, has been in the past and still remains, industrially speaking, little more than a vassal of the manufacturing nations of the world. Each passing year finds her busily engaged in tilling her soil and tending her herds in an effort to find the necessary funds for paying her annual tribute whose principal item is represented by the huge sums expended for fuel, both coal and oil.

Coal in commercial quantities, though probably existing within her vast territory, has not as yet been discovered and worked Neither has the search for it ever been systematically and persistently made. The burning of valuable hardwoods in the furnaces of the Republic on the prodigious scale practiced up to date is suicidal Therefore her visions of a gradual industrial emancipation in the near future depend upon the development of her latent oil resources. Without this her hopes are doomed, but given this development the preamble of her declaration of industrial independence will have been written

The apathy regarding the Argentine oil fields at Comodoro Rivadavia which has existed since their discovery in 1907 up to the past two years is greatly to be lamented In part this indifference may be ascribed to a lack of adequate mining laws, the scarcity of funds for development purposes, and the dearth of technical experience on the part of the Argentine people But the want of real interest shown by the general public looms larger than any of these The Argentine people, accustomed for generations to considering farming, livestock grazing, commerce, politics and the practice of the professions as their major occupations, were not quickly interested in the oil business. Moreover, capital, where lands, cattle, town and city property were not concerned has been timid about investment in new enterprises. The wrecks of so many Argentine mining and industrial stock companies may be pointed out as the causes of this diffidence.

Happily a nationwide awakening to the possibilities for the development of a domestic fuel supply has taken place hereafter each year ought to see more progress than was witnessed during the entire decade between 1907 and 1917, for, Argentina, in the opinion of oil experts, is on the eve of a remarkable expansion in oil production

The discovery of oil in Comodoro Rivadavia did not come as a result of geological surveys which usually guide the drillers' efforts. To the lack of water in this village, founded in 1901 on the barren, wind-swept coast of the Territory of Chubut Argentina is indebted for the discovery of what today constitutes its principal mineral wealth.

In 1903 the Department of Mines began drilling for water at this point with a rotary outfit. An accident occurring at a depth of 500 feet made it necessary to abandon the enterprise before finding water It was only after four years had elapsed that the drilling of another well was undertaken.

In 1907 an outfit capable of sinking a well 1700 feet began to bore the well known as "Chubut No. 2," about one mile north of Comodoro Rivadavia. When a depth of 1600 feet had been reached on December 13, 1907, a stratum of oil-bearing sand was encountered. This unexpected discovery called forth the decree of December 14, 1907, whereby the Argentine Government reserved as a fiscal zone all territory comprised within a radius of four miles around the town of Comodoro Rivadavia.

During the next three years five wells were sunk, all of which encountered either petroleum or gas. During the same period many concessions were obtained by private companies outside of the zone reserved by the Government However, one dry well of 2000 feet, sunk on the beach of Bahia Solana by the Gulf of San Jorge Petroleum Company, represents the entire efforts made by private capital during this period. In 1910 and 1911 Congress voted further funds for development, and made further reservations of land.

In 1913 it became evident that the economic handling of the oil produced made the construction of storage tanks and the purchase of tank steamers imperative. For this purpose a total of 15,000,000 pesos was voted. Since that time the Government oil works in Rivadavia have called for an annual outlay of 1,500,000 pesos in addition to the funds resulting from the sale of the entire production, which varies in accordance with current market prices and the amount of petroleum extracted.

Among the serious problems engineers in charge of these fields have been forced to solve is the question of water, which has to be transported in pipe lines from a considerable distance. Moreover, this water must be obtained from limited natural sources scattered at random in the vicinity of Comodoro Rivadavia. At the same time no port exists in the neighborhood of the field, and vessels have to lie at anchor when loading petroleum from the pipe lines. Due to the frequent storms to which tankers are exposed, a great deal of time is often lost in their loading and discharging.

Up to date approximately 140 wells have been sunk, the larger portion of which are located on the Government reserve. However, a number of private companies have producing wells on concessions immediately adjacent to the territory reserved by the Government. Storage tanks sufficient in capacity to handle a production considerably in excess of the oil actually extracted have been erected in Comodoro Rivadavia and additional tanks are being constructed in practically all of the larger cities of the Republic

It may be stated without fear of contradiction that the oil fields of Comodoro Rivadavia have an assured future in supplying the domestic market with fuel. Their only rival, Mexico, with its enormous production of petroleum, is too far away to continue competing in the Argentine market once Argentina's oil is produced and marketed on a large scale. At present the Argentine Government, as well as private companies, are giving especial attention to the possibilities of refining crude petroleum. This will undoubtedly give a decided impulse to production.

Other known Argentine oil fields are faced with transportation problems which cannot be solved until such time as the demand for petroleum has reached a point where capitalists will feel justified in the construction of pipe lines or railways necessary for bringing the oil to consuming centers. In the meantime Comodoro Rivadavia, with cheap ocean transportation, will be called upon to supply the country with oil.

Evolution in Museum Technique

How the Lifelike Animal Groups of Today Are Executed

An Interview with Dr. F. A. Lucas of the American Museum of Natural History, by A. A Hopkins

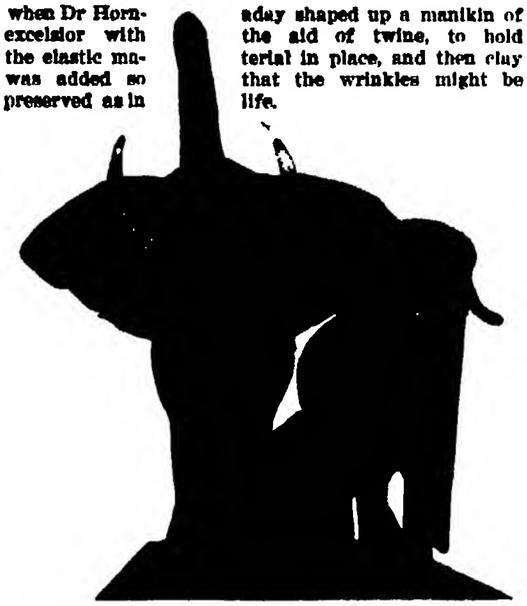
THERE have been changes, even fashions, in the form of presentation of groups for public observation in my time Twenty-five years ago there was scarcely a group of animals worthy of the name, in the United States or in Europe, indeed, for that matter Of course the idea had been crystallized in an early group of large African mammals in Bullock's Museum, in 1815, the panorama, then at its apogee, being employed with the accessories of plants, rocks, etc., but the result was far from realistic, and the product was not very scientific or very accurate Museums with rare exceptions were buried away, and in many cases the reluctant bolt was only drawn back after repeated pulls on the bell which echoed through the cold and cheerless halls. Material was mainly for the use of students who did not need to be entertained or specially educated. A white paper background was considered good museum practice, and as long as the specimens were in a condition to be studied and compared the ends of museum economy were satisfied

I remember that in 1874 Dr Coues, one of our first naturalists and writers on natural history, said "Spread-eagle style of mounting, artificial rocks, flowers, etc., are entirely out of place in a collection of any scientific pretensions, or designed for popular instruction. Besides, they take up too much room Artistic grouping of an extensive collection is usually out of the question, and when this is unattainable halfway efforts in that direction should be abandoned in favor of severe simplicity Birds look best, on the whole, in uniform rows, assorted according to size, as far as a natural classification allows."

I wonder what Dr Coues would say now if he saw the beautiful collections of bird habitat groups on our third floor? Groups we sometimes found in glass cases in private houses, but they were assembled for their beauty rather than their scientific accuracy But it was from the private collection of Mr E T Booth of Brighton, England, that the idea of groups permeated to the public museum, and Mr Booth's collection can still be seen in England's "Atlantic City," for he bequeathed the collection to the town in 1890.

Great names now crowd in on us—R. Bowdler Sharpe, who installed the first "habitat" group in the British Museum before the natural history collections were transferred to South Kensington where Sir William Henry Flower carried on the good work. In this country the new idea was brought forward by that prince of museum curators, Dr G Brown Goode. The old idea of a pedantic naturalist was gradually crumbling to pieces, and we were emerging from an atmosphere of dust and darkness. Now, here I might refer to a pioneer group which was exhibited across the Park in the old Arsenal building in 1869. An Arab courier, attacked by lions, was theatrical and bloody, but drew the crowd and instructed, even if it did freeze the spines of the children

Strange to say this group, which was the first group owned by this Institution, is now in the possession of the Carnegie Museum of Pittsburgh. This group was prepared by Jules Verreaux, a French naturalist, to whose influence we owe the great private natural history establishment at Rochester, from which incubating ground we have such graduates as Hornaday and Akeley. The primitive group was followed in 1880 by a group of Orangs mounted by Dr Hornaday. The technique of animal mounting was on the way, and we have a gradual evolution which may be briefly summarized as follows: The old method was to shape the legs, then reverse the animal, stuff with straw—stretching the hide to capacity, then put all together and fasten on a pedestal. Of course there was an outward resemblance to the animal when the wooden-like product was ready for the case. A built-up manikin followed, and there was more respect for the animal's anatomy. A great forward step was made when Dr Hornaday shaped up a manikin of excelsior with the aid of twine, to hold the elastic material in place, and then clay was added so that the wrinkles might be preserved as in life.



The great African elephant group in the American Museum of Natural History

By far the most notable advance in taxidermy is the method devised by Mr Akeley of modeling an animal in clay, copying all the folds and wrinkles of life, the molding of this in plaster and in this mold making a light and durable form, or manikin, upon which the skin is deftly placed, a method now in general use All the resources of the carpenter, sculptor, and modeller are employed in the fabrication of such accessories as rocks, canes, trees, foliage, flowers, etc., and textiles, celluloid and wax were all laid under contribution in constructing this unique production.

Putting the plaster on the hide to hold the shape while preparing the internal lining

Getting a section of the hide ready for assembling by the Akeley method, the last word in taxidermy

If I digress from great animal groups and describe the methods of dealing with fishes and lower invertebrate life I should provide the material for more than one article, so I will only refer in greater detail to the new Akeley system the latest invention of Mr Carl E. Akeley, who is now in Africa getting specimens for the great African Hall, which will contain the Roosevelt and other trophies.

Now, the Akeley system sounds complicated, but it is simple when you understand the sequence of operations. Of course, you first 'catch your hare," or have your specimen and the hide tanned with vegetable material so that it is soft as possible You then prepare, with the aid of a carpenter and a blacksmith, the necessary armature You then apply modeling clay which is of course, kept wet all the time, as it crumbles if it loses its moisture and model the general form of the animal that is to be reproduced The next step is to apply the soft hide to the carcass in as large sections as possible The sculptor then models all the lines and wrinkles *through the hide* I italicize the word "through," as this is the heart of the Akeley system The third step is to apply plaster-of Paris to the *outside* of the hide so as to make a hard coating or jacket which will hold the hide in place with its manifold wrinkles and lines The sections of skin with their jackets are now taken off, the clay removed, and the inside of the skin treated to a coating of papier-mache and wire cloth which adheres to the inside, preserving the wrinkles, etc, as did the plaster-of Paris on the outside

We now have the skin safely disposed between the two coatings—the plaster on the outside, and the papier mache on the inside Naturally the plaster coating is the one to get rid of so that it is very carefully chipped away and the great section of hide is ready for joining to the rest A "manhole" is left somewhere, for it is little fun doing anchoring in the artificial interior of an elephant Indeed, we can understand now how the soldiers in the horse of Troy must have felt for the case is about the same After every joint is closed with the skill of a furrier, the "manhole" is replaced and the whole animal is waxed and presented to the public

There is no reason why a hide prepared by this system should not last for all time, for the animal or group, can be cleaned like a marble statue and has the advantage of not turning yellow

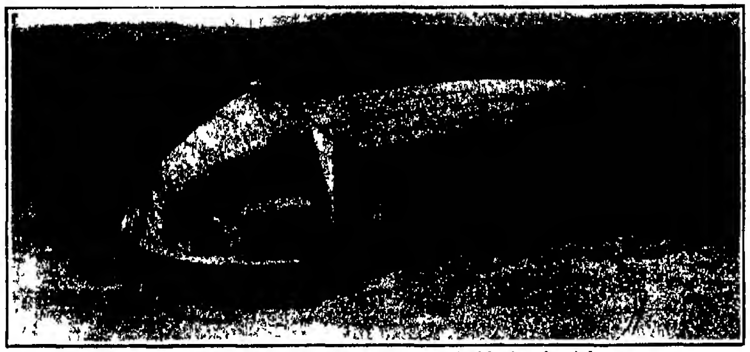
Such is in brief, the last word in museum technique applied to large animal groups, and while we never know what the future may have in store for us, still it would really seem that we had reached the goal

The Formation of Spiral Nebulæ

IN an article on this subject contributed to the *Comptes Rendus* of the Paris Academy of Sciences, M Alex Véronnet examines the effect that would result from the impact of the two components of a binary system He shows that the energy produced by the friction at their surfaces is the most important factor, and that a mass equal to that of Jupiter might produce by impact with the sun a temporary increase of light amounting to twelve magnitudes. Radiation pressure would then expel the heated particles with high speeds, and the revolutionary movement of the stars would give a spiral formation to the scattered particles. The author seeks thus to explain the phenomena both of novæ and of spiral nebulæ. He concludes that the latter would undergo a rapid evolutionary transformation (in the course of a few centuries) It would seem, however, that the larger spiral nebulæ are on too grand a scale to be the product of the impact of a mere pair of stars. The hypothesis is, however, worth considering in relation to such nebulæ as that revealed round Nova Persei and Hubble's variable nebula in Monoceros.

The Problem of Mooring Airships

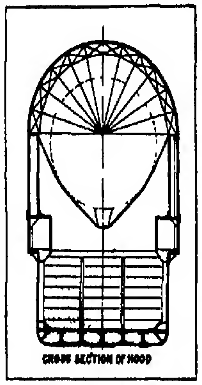
Proposed Method for the Safe Landing of Dirigibles, and Mooring Them Head to Wind



A landing platform which permits a dirigible to land head to the wind

EVERYONE who has followed the development of lighter than air ships must have realized that a large proportion of the accidents which have befallen them has occurred when these great structures were in proximity to the ground. Sometimes as the ship was emerging from the shelter of its shed and before it was completely clear, a side wind would carry it against the side of the shed and cause a rupture of some of its members. To guard against this liability lofty windshields of boarding were erected in the lee of which the airship found quiet, or comparatively quiet air, and was able to leave and return to the hangar without the risk of collision with the shed.

The difficulties involved in entering a shed when a side wind is blowing is similar to that experienced by the big Trans-Atlantic liners if they attempt to warp inside the Hudson River piers when a heavy current is setting up or down the North River. In such cases it may take as many as a dozen powerful tugs to hold the big ship athwart the current as she moves cautiously to her pier. The large liners, on this account, prefer to come up to their docks during slack water, at the turn of the tide. Similarly the captain of an airship would prefer to make for the protection of the shed in still air or when the wind was blowing along the length of the shed and parallel with the ship. Not many people appreciate the magnitude of the total side pressure upon an airship, due to its great length of six or seven hundred feet, and its diameter of seventy to eighty feet. The total area exposed is so great that even in a moderate summer breeze the total pull which the crew on the ground have to resist in a cross wind may readily exceed a score of tons.



Section through hood

There is a parallelism between the airship and the steamship which has a significant bearing upon the problem of landing. Both are sustained in a fluid medium which is their natural home and which they should never leave except when constrained to do so by sheer necessity—that is to say neither the steamship nor the airship, should touch solid ground except under special conditions, and when every precaution has been taken to avoid damage or disablement. The steamship's hull is not designed primarily for contact with the land but rather to rest on a yielding fluid. And of all the dangers of the sea, there is none which the ship's captain avoids so carefully as that of bringing the comparatively frail hull of his ship in contact with the ground whether it be a rocky shoal or the smooth flat surface of a sandy shore. When the ship does have to rest upon the land she is taken into an expensive and specially designed drydock, where, as the water is pumped out she comes to a bearing very slowly upon a bed of timber blocks, which have been so distributed over the floor of the dock as to avoid any excessive pressure being brought to bear upon any particular part of the vessel.

If the reader has ever witnessed the docking of a big ship, or any ship for that matter he must have been impressed with the extreme care with which the operation is carried through. Very slowly does the vessel come up the channel and enter the yard where she is to be docked, and even more slowly does she creep up to the dock entrance under the watchful eyes of the officer on the bridge, and of the docking master ashore. Now all of this caution is based upon the fact that the ship is a huge and heavy structure with a comparatively light and fragile shell, which would be heavily strained if not broken, when a too sudden contact with a pier or any solid and immovable object would arrest the great momentum in the moving ship, with disastrous results.

When a ship of the sea is not tied up to a dock, she is moored by the head, in water of sufficient depth to float her at all times, and with a sufficiently large unobstructed area of water around her mooring to permit the vessel to swing head to wind, or head to tide. Under these conditions, the primary pressure upon the ship is *only a fraction of what it would be were* either the tide or wind, or both together, moving athwart the vessel's position.

The above conditions, as they effect the ship of the sea, apply *pari passu* to the ship of the air. She should as far as possible float in her native element, and be sent into drydock (in her case the airshed) only when it is absolutely necessary. It is desirable, when she goes into port, to prevent, if it be possible any direct contact between her delicate hull and the solid mother earth. Moreover, in starting on a trip, or in returning, or while she is in port, it is desirable that she should move up the wind to her mooring, and as far as possible be free to swing head to wind while anchored.

With a view to meeting these requirements the Vickers Company developed the lofty mooring mast, as first suggested many years ago by the SCIENTIFIC AMERICAN. This mast is a stout latticed steel structure, to the top of which the air ship is moored by a cable which extends from the mast to the nose of the ship. The sheave at the top of the mooring mast through which the mooring cable passes, is arranged to swing in a horizontal circle and the moored ship is free to swing at all times head to wind. Experience has shown that, because of the streamlining of the dirigible, the stresses upon the mooring cable and upon the nose of the airship are moderate and it has proved to be an easy matter for a crew of three or four men to maintain the ship on a level keel. Vessels have been moored in the open in this way for several weeks on end, during which they have ridden out some severe gales without damage.

We present on these pages illustrations of two different types of airship mooring, one for use on shore, and the other on the water, which the designer, Mr John Mason of Cape May City, N J, has developed with the idea of combining the head-to-wind advantage of the mooring mast, with certain of the facilities which attach to the fixed airship shed.

In the design shown, in the top left hand picture, provision is made for an all the year-round landing platform for dirigibles, combined with a supply station, repair shops, and a lee tie-up in all bad weather. It consists essentially of a platform of sufficient length and width to carry the largest dirigibles. At its forward end the platform widens out into a circular head, which is about 200 feet in diameter. It is supported at intervals along its length by a series of flat cars which run upon concentric railway tracks as shown in the illustration. At the forward end of the platform is built a semi-conical structure, which plays the part of shed and windshield for the forward end of the dirigible. On either side of it are built machine-shops and store-sheds. The windshield is lighted by port holes, and it is surmounted by a pilot house, from which the dock master through radio telephone, keeps in touch with the pilot of the approaching airship, and controls the motors by which the mooring platform is moved. It should be explained just here that in the exact center of the circular forward portion of the platform is a large vertical hollow pin, which engages a bearing set solidly in the ground. About this pin the whole structure rotates.

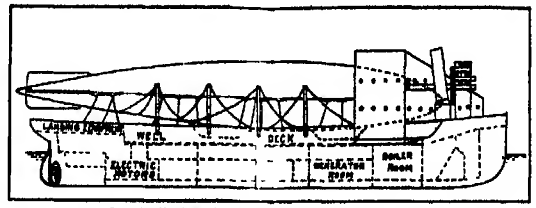
A very nice point to be decided was how to hold a dirigible three-quarters of whose body was exposed to the weather, with a minimum danger of severe straining or shock. The method adopted was to carry the ship in a series of broad flat, flexible slings of reinforced fabric, passing under the hull of the dirigible and made fast at the top of a series of carrying posts arranged down each side of the platform. Some of these slings, as will be seen from our drawings, extend under the hull from post to opposite post, so that they lie in a plane normal to the longitudinal axis of the ship and others extend diagonally between the posts. The dirigible is held down against the slings and clear of the platform by means of vertical cables reaching from the hull down to the mooring rings along each side of the deck. By this arrangement the ship is held firmly, but flexibly, in place, without coming into contact with any rigid parts of the platform or its gear. And the supporting contacts with the slings and cables are sufficiently distributed to avoid any tendency to break the ship in two.

A Mooring Barge for Dirigibles

The principles of construction used for the radial mooring platform on land, are used also in the dirigible mooring barge, which is represented in the upper right-hand illustration on this page. There is the same hood, or windshield, surmounted by its pilot-house, the same series of posts ranging down the sides of the hull of the pontoon, and the same system of supporting the slings is employed. The hull consists of one large pontoon, with as many smaller ones attached behind it as the length of the dirigible requires.

It will be seen at once that the head-to-wind conditions are insured by mooring the pontoon from the bow. The mooring ground would, of course, be selected where there is no strong tide or current, and would be located, preferably, in the back waters of harbors, or upon lakes that were conveniently available. In the case of the mooring pontoon, the machine shops, storage for spare parts, accessories, fuel and other facilities of shop and shed are provided for in the forward portion of the pontoon below the windshield.

Landing pontoon, in sections, which carries the airship in broad flexible slings



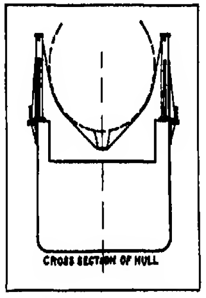
Longitudinal section through seagoing airship carrier

A Sea-going Dirigible Transport

The most normal and daring proposal of Mr Mason is to build the great dirigible mother ship which is shown in the adjoining illustration. When we remember that the largest dirigibles are about 700 feet in length it will be understood that the proposed ocean going ship to house and carry one of these dirigibles must itself approach in size the largest steamship dimensions. The wash drawing and three-line drawings of this vessel will make clear what the designer is attempting to do. The mother ship would be a steel vessel about 800 feet in length by 90 to 95 feet in breadth. Forward and 40 or 50 feet from the stem head will be a three-deck bridge structure, containing accommodations for the captain and officers on the lower deck, the chart room and the captain's staterooms on the intermediate deck, and the pilot house and bridge on the top deck. Abaft this structure, one on each side of the windshield, will be two elliptical funnels with uptakes leading from the boiler room, which is located in the forth compartment aft from the bow. Abaft of the boiler room is the generator room with the firemen's mess located on the deck above. Aft of the generator room are the blower room, and a compartment in which is housed a powerful gyro stabilizer. Further aft are machine shops, store rooms, etc. Electric cables lead from the generator room to the electric motor room, which is located in the last compartment but one toward the stern.

Down the sides of the ship will be noticed a series of tripod masts, from which the various belts of the carrying crate pass below the hull of the airship.

The use of the electric drive insures that there will be ample electric power for the manipulation of the many winches, to which the landing ropes of the dirigible are led when she is leaving, or returning to the *mother ship*. In making a landing the mother ship will steam head-to-wind, and the dirigible will do the same, coming up over the ship until it is possible to drop the mooring cable on deck. Here it is fastened to a cable which leads forward into the nose of the windshield where turn is taken around a powerful electric winch. As the airship descends closer to the mother ship, other landing ropes are dropped and carried to electric winches the result being that the dirigible, in spite of its great size is gradually pulled down, against its positive buoyancy, into the carrying slings, and there made fast.

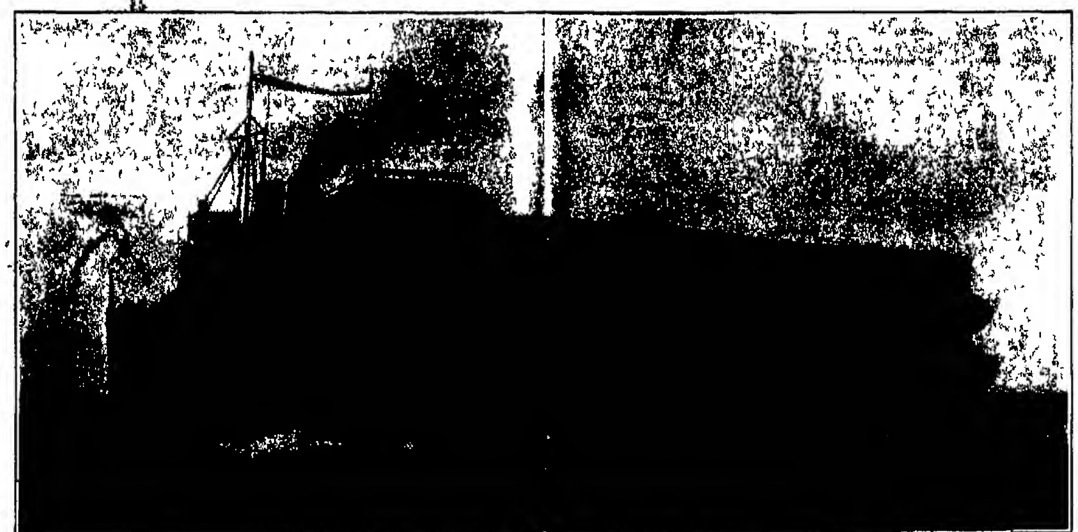


Section showing well and cradle

We have spoken of this mother ship as a daring proposal and such it is but the designer is taking a long look ahead and he believes that if two of these ships were built and given sufficient speed to accompany the main fleet, they could provide four large dirigibles for such operations no matter how far afield the fleet might venture in search of the enemy. Mr Mason believes that two such ships could maintain four dirigibles, for the reason that while two were in the air the other two could be refueling and undergoing such overhauling as was necessary.

The question of stability of course, would have to be carefully watched at all times, but the fuel supplies, and the free use of water in the double bottom, should take care of that problem.

These three designs are presented as being a thoughtful study of one of the biggest if not the greatest problem—namely, that of landing and housing, which confronts the large airships of today.



A proposed airship carrier, designed to accompany a battleship fleet

The Relation Between Body Size and Organ Size of Plants

IN the *American Naturalist* for October 1921, Dr Edmund W Sinnott of the Conn Agricultural College presents a paper on the relation between Body Size and Organ Size in Plants.

In the animal kingdom, particularly among its more highly specialized members where the primitive condition of infinite multiplication of smaller organs has given way to a high degree of differentiation there is necessarily a close correlation between the size of a given organ and the size of the organism of which it forms a part. A particularly large individual will tend to have proportionately large bodily structures and *vice versa*. In the case of the higher plants, however with their multiplication of similar organs and their notably lower degree of organization and individuation, an interdependence between body size and organ size is certainly much less obvious. We need only to call to mind the general similarity between leaves or fruits from small and large trees to realize that in these larger woody plants, at least there is no very striking correlation between the size of the body and the size of its parts. In certain herbaceous forms however evidence has from time to time been brought forward that such a correlation does in fact exist and that the largest plants (whether measured by dry weight height number of stalks or yield) are those which bear the largest fruits and seeds. The author's paper is the result of a study of a group of 762 bean plants growing during the summer of 1918 as a part of a larger investigation. The beans were Red Kidneys, and although they were not members of a pure line they were so similar in all characters studied as to indicate that no wide genetic differences existed among them. Seeds of uniform size were selected and were planted June first. The soil of the plot varied decidedly in fertility with the result that some of the plants grew luxuriantly many of them reaching a total dry weight of 150 grams whereas others were much dwarfed reaching only 4 or 5 grams at maturity. The bulk of the population was intermediate in size.

Over two hundred of the plants were harvested from time to time during the summer representatives of all stages from the young seedling to the appearance of flowers being obtained. The rest 144 in number grew to maturity and were harvested then. The number of leaves, pods and seeds were counted and dry weight determinations made of the total bulk of the leaves, of the stem system and of the yield of fruit separate determinations being recorded for total pods (without seeds) and total seeds. From these data the dry weight of the entire plant, of the vegetative shoot and of the reproductive structures could easily be determined as well as the average weight of leaf pod and seed for each plant. Correlations were then made between the average weight of each of these organs respectively and the size of each plant. The latter was represented either by the weight of the shoot (stem plus leaves) the weight of the fruit (yield), the number of leaves, the number of pods or the number of seeds.

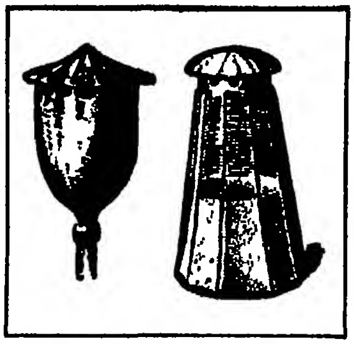
The author presents a number of correlation tables study of which leads him to conclude that the size of the plant body is not the direct causative factor in determining the size of the leaves, fruits or seeds which it produces as has been suggested or implied by many investigators but that the size of any given organ depends rather upon the size of the growing point out of which it has been developed. Any factor be it age, moisture or food supply which alters the size of the meristem will thus alter the size of the organs produced by this meristem. There seems to be nothing in these higher plants closely corresponding to the definite organization in the animal individual, where size of body is definitely related to size of organs,

Plants as Inventors

Sound Engineering Principles Practiced by Members of the Vegetable Kingdom

By Dr. Alfred Gradenwitz

WHEN, about 30 years ago, the validity of statical and mechanical relations was first discovered in the realm of botany, experimenters, truth to say, marvelled at the unexpected agreement between the inventions of human engineering and the devices employed by vegetable as well as by animal organisms, but they dared not face the conclusion that the same invariable law manifests itself in the structure of living beings as well as in the creations of man A more plausible hypothesis was found in the belief that the products of Nature are rough approaches to human achievements, the perfection of which, so far from causing us to regard Nature as a superior teacher of man was the subject of universal admiration.

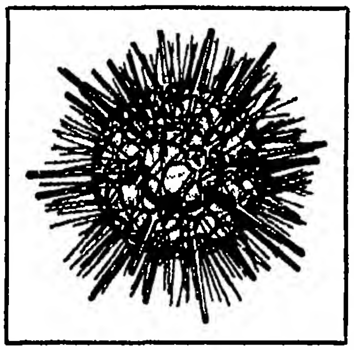


The seed caster of the poppy, and an adaptation to household and medical purposes

In a book both attractive and instructive ["Die Pflanze als Erfinder," Franckhsche Buchhandlung, Stuttgart], Professor R H Francé, on the contrary, suggests that human engineering never could do anything beyond obeying the law of cosmic structure as well as of living plasma, that the inventions of Nature far outdo from the point of view of many-sidedness, perfection and efficiency those of the human mind, and that no more fertile task could be imagined than deriving knowledge and suggestion from the infinite series of natural models.

The seven constructive elements — sphere, crystal, plane, staff, band, screw and cone—the same elements on which human engineering is based, are found again in Nature's own creations. To her as well as to man, they are the indispensable fundamental elements, and neither Nature nor human art or engineering knows of any form that could not be reduced to them

"On my writing desk," says Francé, "there is a bunch of fresh wild flowers looking at me Every week they are different, each time a handful at random taken from the midst of Nature's life With a marveling mind, I am analyzing their forms Leaves and petals are planimetric surfaces, the crowns of campanulas show the rounding of spheres, the forms of cones are combined with plane surfaces The same as in a rococo ornament, the conchoid and helical surface, both derived from the spiral are reverted to, time and again, the stems are rods—all fundamental elements, though bearing the stamp of reasoned life, are developed and complicated to the highest possible degree, but after a quarter of an hour's searching and thinking I have failed to detect anything but the seven fundamental forms of the universe, and I give up any further attempt in dispair"



One of nature's characteristic forms which is in fact a marvel of stability and economical construction

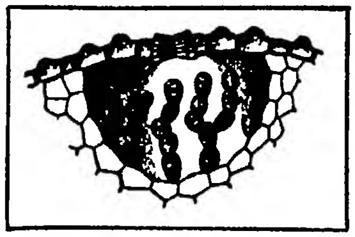
Francé was in a most remarkable manner led to these considerations. Being in need of a shaker for the sake of a biological experiment, and having in vain tried to obtain it in trade, he was eventually struck by the idea that Nature, for the spreading of spores and seeds, ought to have created something suitable In fact, the capsule of poppy turned out to contain what he was looking for, the holes arranged below the lid of the capsule actually constitute a solution of the problem superior in efficiency to all human constructions previously put forward. Francé was the first to find this by actual experience, and a patent applied for to protect a caster accurately imitating the natural product was readily granted.

"This is," says Francé, "how a new science sprung up, the science of Biotechnics," whose task it is to investigate the mechanical attachments of Nature and to derive therefrom suggestions for human engineering.

A fact which, according to him, can be stated quite generally, is that every process in Nature occurs in the most advantageous manner, that is to say, with the maximum possible efficiency "The shortest way in which a process reaches its end is its natural law the smallest resistance offered by an object to the production of its permanent state of rest is obtained by assuming its most suitable form, *i.e.*, its functioning in a mathematical sense." The same fact could be expressed in a more simple and commonplace way by saying that "to every process corresponds a given technical shape"

The correctness of this proposition can be confirmed already in connection with the cell, the fundamental element of all organisms Being liquid and plastic, the protoplasm possesses the faculty of assuming any shape corresponding to the actual function of the cell When ever, however, the cell remains at rest, as soon as all processes within it have come to a temporary standstill it necessarily reverts to "the prototype of all shapes, the sphere"

Generally speaking, shape enables function, the cause of shape, to be ascertained. The various *crystalline* forms, accordingly, are the expression of given conditions of stress and pleasure, which under otherwise equal circumstances always obtain in the same manner Everything intended to exert a pull must be *band* shaped, muscular fibres as well as driving belts. In fact, bands are the most advantageous technical realization of pulling organs. *Staves* will alone serve as supports The same as the old man leans on his staff, the same as a temple roof rests on staff-shaped columns, palms grow column like trunks to rest their crowns upon, corn will balance its ears on stalks that are hollow staves, and the most minute mono-cellular organisms will put forth staves, "whenever supporting functions belong to their habits of life"



A vegetable power-plant from the moss Marchanita, in which the sunlight is made to give up its energy

The *helical shape*, in its turn, is the only possible in the case of drilling effects, whenever there is anything to be pierced. "The tiny microbe will thus screw its way through the world of the water drop, the dreadful *spirochaeta* is by its helical shape enabled to penetrate all tissues, to get between all the cells of its victim, the light, helical form of the winglets of maple fruits serves for aerial propulsion just in the same way as airplane propellers and just the same as the enormous propeller screw of ocean steamers serves for 'screwing' through water"

"In fact, it is not we who, after all, have invented screws, drills, propellers, neither is it the microbes and mastigopods and plants, nor finally the air, which, of course, moves quickest in helical whirlpools, —but above all facts of Nature there is ever towering a law intimately based on the structure of the world, that movements occurring in spiral lines will overcome resistances more readily than movements in straight lines, and that, accordingly, movements will take place much more frequently when adapting themselves to the form of a spiral than in the opposite case"

"Crystalline forms, sphere, plane, staff and band, screw and cone, these are fundamental engineering elements of the whole universe. They are sufficient for all processes of the whole of cosmic life, controlling them in the best possible manner Whatever there is, is some combination of these seven fundamental forms, though there is nothing beyond the holy seven. Nature has produced nothing else, and the human mind will create whatever it may, without ever reaching anything but combinations and variations of these seven fundamental forms." In fact, "the laws of minimum resistance and of economy will cause the same activities always to result in the same forms, so that throughout the whole universe all processes will always have to occur within the compass of the seven forms of all being"

In the further course of his treatise, Francé discusses a number of typical vegetable organisms, first of all, the flagellates or mastigopods, which according to the law of minimum resistance, always assume the form of a narrow hull adapted for dividing the water Floating as they all do below the surface of the water, they constitute the prototype of submarine. In the place of the keel otherwise provided, many such organisms (which are known to be at the boundary between the vegetable and animal kingdoms) comprise an attachment serving as rudder as well as for increasing stability, of which modern shipbuilding has not yet made use, but which is to be found with airships. When being shown by Francé the design of a ship imitating the shape of such a mastigopod, one shipbuilding engineer was most surprised at noticing a type of vessel so far unknown, but which with equal coal consumption, would be able to obtain higher speeds. "The solution of the problem of ship motion by the whip-shaped screw of flagellates," says Francé, "is an ideal case of economic achievement. While, in order to obtain a speed of, say, 23 knots per hour engines of 40,000 to 70,000 h p. with an enormous consumption of coal, must be resorted to, a tiny monad, according to my calculations, in proportion to its size (the monad being assumed to be 1/100 millimeter, the rapid steamer 200 meters in length), will obtain, not a speed of 4.2 millimeters per hour, as corresponding to the best of our rapid steamers, but effects 80,000 times better! In fact, the monad, with the aid of its whip screw, is able to hurry through 20 millimeters per second. So very much superior are organic structures to those of human engineering, and such possibilities are opened up by the way entered on with the foundation of biotechnics!"

Natural models of the most diverse turbine types are offered by the sea in these minute plants by millions floating at its surface and at most measuring a fraction of a millimeter, which are termed *Peridinea* and which, out of cellulose, build for themselves an armor, some sort of controlling apparatus by which the motion of the surrounding water is forced into given paths, thus causing the whole body to rotate like a turbine rotor. Each of the 160 species of *Peridinea* known to botanists constitutes a modification of its own of the turbine principle, whereas engineers at most know of a dozen turbine types. The design of turbines thus might, in its turn, derive ample suggestion from biotechnic studies. Nor should it fail to take into account the *Diatomaceae*, constituting ingeniously designed minute turbine ships.

The urn-shaped leaves of Dischidia, which constitute an ideal refrigerating machine

Francé further draws attention to the fact that the membranes of vegetable cells normally will stand a pressure of 5 to 10 atmospheres, that is, the same as the walls of a small steam boiler. Nay, in the cells of sugar beets a membrane 1/1000 millimeter in thickness stands a pressure of 21 atmospheres, and whereas a steam boiler requires walls of a thickness about 1/30 of the boiler diameter, those of the vegetable boiler are barely thicker than 1/000 of the diameter. To this point is Nature's own engineering superior to that of man.

A single vegetable leaf further combines in itself the installations

of a large modern industrial plant. In it, there is a complicated ventilator at work, further a drying apparatus, an infinite number of admirable "light engines," a refrigerating machine and an hydraulic press. Most remarkable among these are the "light engines," having no equivalent in human engineering, viz., attachments by means of which the chlorophyll will catch the carbonic acid and with water convert it into starch, in which connection the beams of light play the same part as the steam in a steam engine. The vegetable leaf thus works with the cheapest, most ubiquitous source of power, the energy of sunbeams, and likewise with the least expensive of raw materials, air and water, which are found everywhere. Moreover, vegetable refrigerating machines have been shown by Francé to embody the principle of the Linde ice machine, if deprived of their refrigerating mixture, they would constitute excellent condensers.

Francé draws attention to the "waterworks" of trees, which, in spite of all attempts so far made, have remained unexplained, installations by means of which, *e.g.*, the mammoth trees of California will raise the life-giving water to a height of 142 meters, the eucalyptus of Australia even to 152 meters, an achievement not even approximately equalled by human waterworks.

The most hopeful conclusion derived from Francé's considerations is that human engineering could keep itself busy for centuries to come, creating an infinite wealth of new and ever more improved machines, if only the more important vegetable inventions so far known were to be assimilated

It is not the plant that creates its technical apparatus nor the human mind that produces marvels of engineering, but in both of them unconsciously to themselves there is the same principle at work

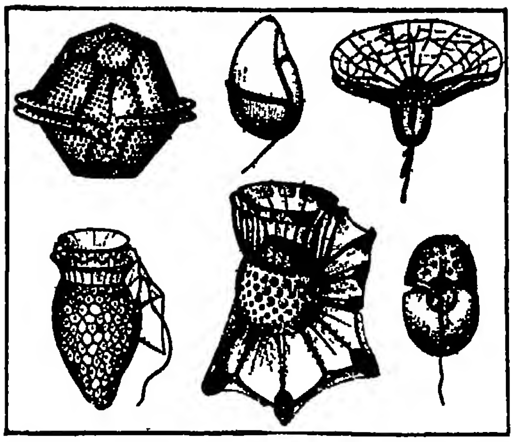
Gravitational Absorption

MAJORANA, in an interesting series of contributions to *Atti della Reale Accademia dei Lincei*, abstracted in *Philosophical Magazine*, 39 488, 1920, has proposed a new theory of gravitation, in support of which he offers experimental evidence adduced from certain delicate pendulum demonstrations. He assumes that matter is not completely permeable to the gravitational force, but that the latter is to some degree weakened in transit through all material bodies. Where, under the Newtonian law, the attraction between two particles is equal to the product of k, the ordinary gravitational constant, M_1 and M_2, the respective masses, and the inverse square of the distance r Majorana attaches a further factor, in the form of the natural logarithmic base, e, carrying a negative exponent that is numerically represented as the definite integral of $h\rho dr$ over the entire line r, h being a second universal constant of gravitational absorption, and ρ the density of the intervening matter, numerically or as a function of r, as the case may be.

In consequence of this absorption, the attraction of any large body upon objects outside it would be diminished, and its "apparent mass," measured by means of this attraction, would be less than its true mass. Dr Russell, familiar to the readers of our astronomy page, investigates some of the astronomical consequences of Majorana's theory in a recent issue of the *Astro-Physical Journal* He finds that, on the hypothesis that there will occur no change in the inertial masses, the value of h determined by Majorana (6.78×10^{-12} in c-g-s units) would, under the most favorable conditions, result in a displacement of Jupiter from his position as ordinarily calculated more than 500 times the lower limit of observation, while the whole lunar theory would be wrecked by a similar effect of 10,000 times greater than the smallest we could hope to note. Moreover, if we assume that, with this value of h, the apparent mass takes the place of the inertial mass for gravitational purposes, the tidal phenomenon on the earth's surface would vary, as between the time when both sun and moon are below and when they are both above the horizon, by an amount exceeding the observed difference by more than 5000 times the observational limit.

With these results he couples the very obvious statement that, dealing as he does with an apparent change in weight amounting to one part in 12000 millions, Marjorana cannot possibly hope to cut down the effect in question by 5000 or 10,000 and keep it above the threshold of observation so far as laboratory determinations are concerned. His whole theory must therefore fall, not merely the volume of h which he proposes.

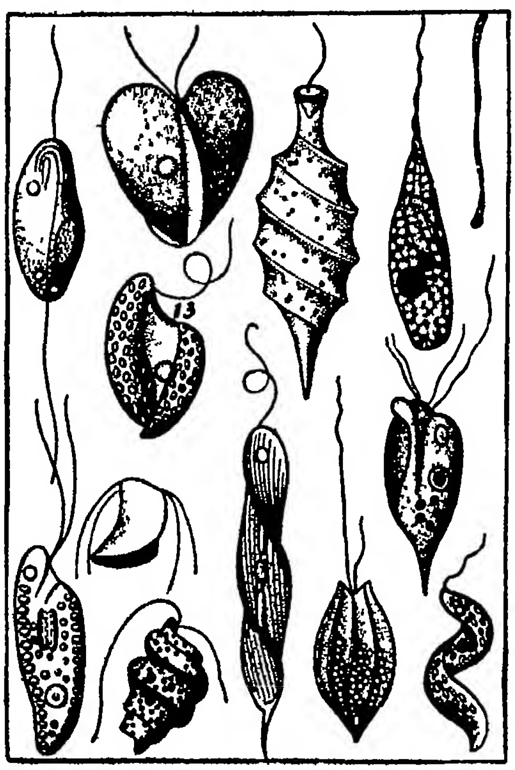
But what then becomes of Marjorana's long and careful series of experiments? If their result is accepted, it seems necessary to interpret it as showing that the mass of one body (his suspended sphere of lead) was diminished by the presence of another large mass (the surrounding mercury), that the effect was a true change in the mass (since inertial mass and gravitational mass are all the kinds of mass that we know of), and that it depended on the proximity of the larger mass, and not upon any screening action upon the earth's gravitation



Peridineae of the sea, natural turbine models to which Prof. France attributes an efficiency greatly in excess of any man-made turbines

Strange as this notion may seem, it is not inherently absurd Indeed, if the phenomena of gravitation and inertia may be accounted for by assuming that the four-dimensional "world" possesses certain non-Euclidean properties, or "curvature, both in the presence of matter and remote from it, it is not very surprising if the curvature induced by one mass of matter should be modified to some degree by the superstition of the curvature due to another, so that the effects were not exactly additive

A great variety of assumptions may be made regarding such an influence, and many of these might have the advantage of giving a conservative field of force, which Majorana's did not Complications are still likely to arise For example, consider a large spherical mass, alone in space and gradually contracting upon itself while it moves forward in a straight line Its mass will presumably diminish as its various parts come closer together; but what will happen to its velocity? Presumably this would increase, but it seems obvious that either the conservation of momentum or the conservation of energy would have to be abandoned, if not both Come next to a planet revolving in an eccentric orbit about the sun. Its mass will diminish at perihelion, and this will probably lead to changes in its orbital velocity The resulting alterations in the orbit will depend on the law of change of velocity, and it might be possible to invent a law which would lead to conclusions consistent with observation



A collection of flagellates embodying the prototype of the submarine, together with numerous helical shapes admirably suited for locomotion

Further speculation on such matters seems, however, to be premature, when it is considered that the whole structure would rest upon the observation of a change in weight amounting to one part in 12000 millions. Discussion of the possibility that some undetected systematic error has crept into the results, in spite of the great care taken to eliminate such errors, or to correct them must be left open. It is to be hoped that the further experiments which Majorana contemplates will provide the data regarding the actuality, the magnitude and the laws of variation of the suspected influence, which now are so evidently desirable.

Ecological Relations of the Eskimo

IN *Ecology* for April, 1921, Dr W E. Ekblaw, Geologist and Botanist of the Crocker Land Expedition, offers a most interesting article on the ecological relations of the Polar Eskimo The author says, in part

The Polar Eskimo, who inhabit the northwest portion of Greenland contiguous to the waters of Smith Sound are the northernmost people in the world. Along 800 miles of desolate shore, from Cape Seddon in latitude 76 to the Humboldt Glacier in latitude 79 degrees north, they have persisted for centuries as a unique little social group of about 250 individuals, quite successful in their hard struggle for existence by an almost perfect adaptation to the rigorous conditions of their far northern homeland Their number determined by the years of minimum food supply has probably never been much greater or much smaller than now

Their homeland though extensive, is small in area because the Greenland ice-cap which covers practically all the high plateau of Greenland restricts all life to a narrow belt along the shore free of ice and snow during the short summer Their climate, though Arctic, is essentially oceanic The periods of continuous day and continuous night are longer than those with any other people

The Eskimo are a distinct race with distinct character, language and culture Small of stature but of powerful physique, the Eskimo compare favorably in physical development with the most splendid races in the world They possess some characteristics of the North American Indian in form and figure Some characteristics link them with the Mongolian Nevertheless they are a distinct race with their own distinctive language and their own peculiar culture The total number of Eskimo probably does not exceed 40 000

The Polar Eskimo constitute a relic of the last wave of migrants which swept down the west Greenland coast subsequent to 1000 A.D, displacing the Norse Settlements then established there and a later element introduced in the middle of the nineteenth century by an immigration of several families from Baffin Land, who introduced new elements into the culture of the natives, and profoundly modified their mode of life

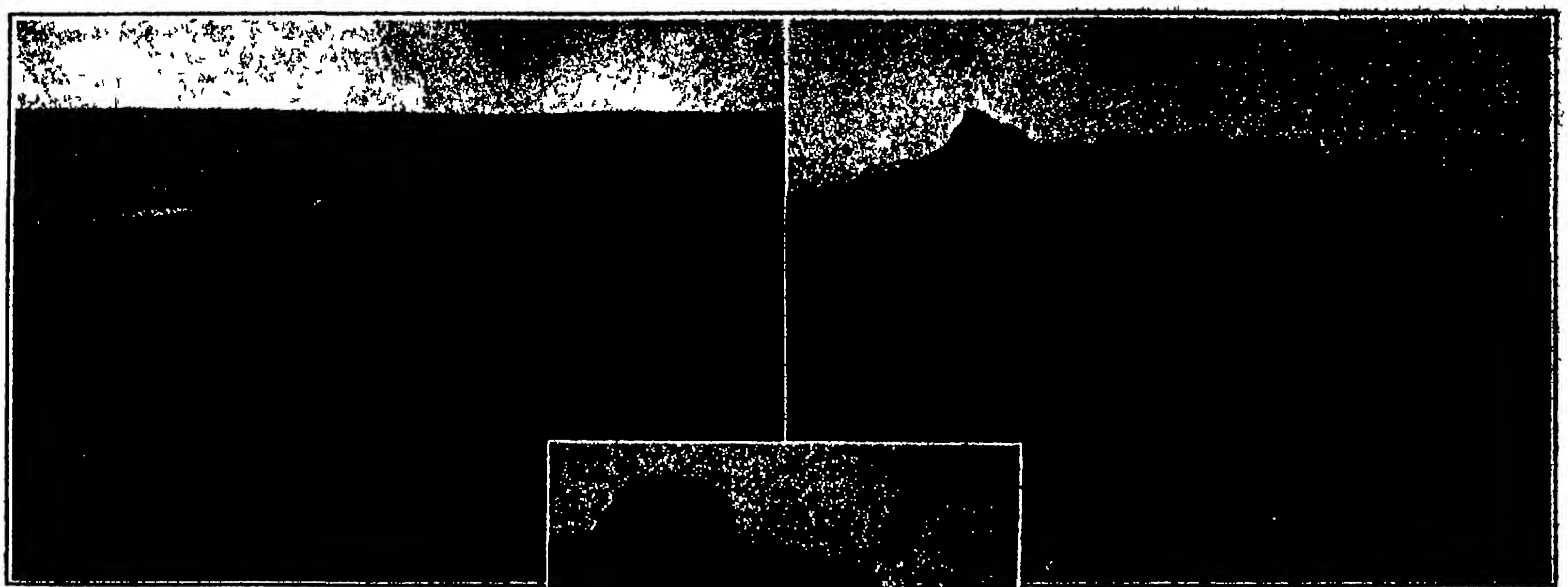
As a consequence of these two elements in the group the Polar Eskimo exhibit two distinct types. One of these, represented by the descendants of the earlier settlement, is characteristically Eskimo—short and stocky of stature round and flat of face flat of nose, stolid of countenance, and with a tendency to *piblokto*, a form of Arctic hysteria The other type, represented by the descendants of the later immigration from Baffin Land, is suggestive of the Indian—taller, lither body, higher cheekbones, longer face, almost aquiline nose, alert countenance, and absence of *piblokto*

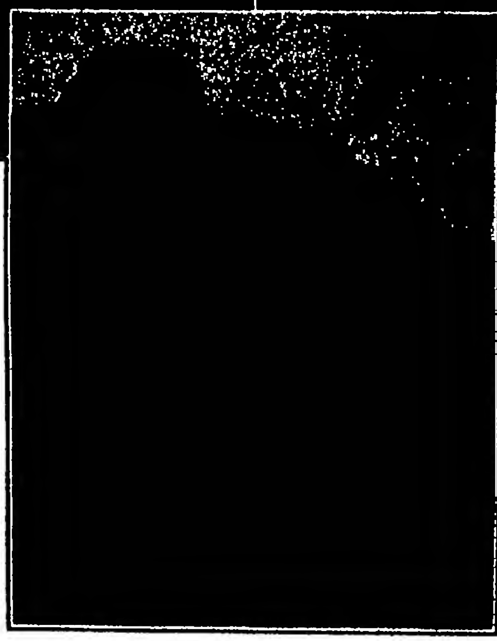
Various factors, climatic, biotic, etc., are then discussed, and the conclusion is reached that to the environment in which the Polar Eskimo live, their every thought their every activity is adapted Their character, their culture, their industry, are determined by their habitat,

However, recent contact with the white race is changing the Eskimo's mode of life, his culture, his character, so that they are no longer solely the effect of his environment The introduction of lumber and iron has improved his sledge so that he can travel farther The *primus stove* and *Standard Oil Company kerosene* have further extended his activities and his range of travel. Rifles and ammunition have transformed his hunting methods and increased his stores of food, clothing and fuel, and made hunting and living easier Needles, and thread, and cloth, and cooking implements have immeasurably aided the Eskimo women Tea, coffee and tobacco are insidiously weakening the Eskimo physique By contact with foreigners the Eskimo is losing his native honesty, independence and sterling character He is changing so fast that in another decade or two he will be quite another person His direct relationship to his homeland will be lost and his dependence upon the exterior world finally established The demoralization of the Polar Eskimo as a distinct social unit is imminent and inevitable.

The Great Wall of China

A Geologist's Examination of the Oldest Artificial Structure in the World





Three views of the Great Wall of China, at widely scattered points

THROUGH the courtesy of Mr Frederick C. Clapp, a well known petroleum engineer who has carried on some interesting explorations on the Great Wall of China, we are enabled to reproduce these splendid photographs, and the text, too, is abstracted from Mr Clapp's paper in the *Geographical Review*. That the wall is actually the oldest extant artificial structure is of course not the case, that it must, in the eyes of anyone who gets a comprehensive view of it, stand as the most impressive landmark on the face of the earth, is evident. Not in its height and breadth alone does it appeal, but in its length and continuity, and in the magnitude of the task which was accomplished in its building twenty centuries ago.

Starting at Shanhaikwan on the Gulf of Liaotung, the massive masonry and brick wall runs far into the interior of the country. It maintains a uniform direction for hardly a single mile. It climbs mountains and crosses valleys, and is so crooked that to reach the eastern bifurcation near Sihai, an air-line distance of 125 miles, it takes a course of about 300 miles.

An adjunct to the wall, known as the Palisades, began on the Yalu River and connected with the wall proper on the Manchuria border north of Shanhaikwan. This line is given on many maps as that of a ruined wall, but Mr Clapp crossed it without finding any trace of it, so it is evidently not everywhere preserved. There is historical record that it extended for at least 400 miles into Manchuria.

At Sihai, about 40 miles north of Pekin, at an altitude of 8300 feet, the wall branches, the inner loop trending southwest while the more northerly branch continues its mountainous way across western Chihli and the whole breadth of Shansi province to the Hwang Ho, where it rejoins the other loop. This distance in an air line is 380 miles, but the northern wall uses up 500 miles in covering this ground, while the southern loop, with a branch that runs off to the south, is some 630 miles long.

This double wall marks the region of greatest menace from the Mongols. Along the northern course brick watch towers and signal stations mark all the prominent hill tops, and from these we may conclude, signals were flashed whenever the invading horde had succeeded in breaking through the outer barrier.

Without going into too great detail as to the further course and the branches of the wall, we can state that Mr Clapp traces the main course of the barricade for 1850 miles further, far into Chinese Turkestan, with 750 miles of branch wall in Tibet and other regions. So he finds for the main wall a length of 2150 miles, and for its branches a total of 1780 miles—3930 miles of construction altogether. This is comfortably in excess of the length attributed to the wall by Chinese legend, and more than double the most conservative estimates of previous explorers. The highest figure ever before stated, including branches, appears to have been 2500 miles.

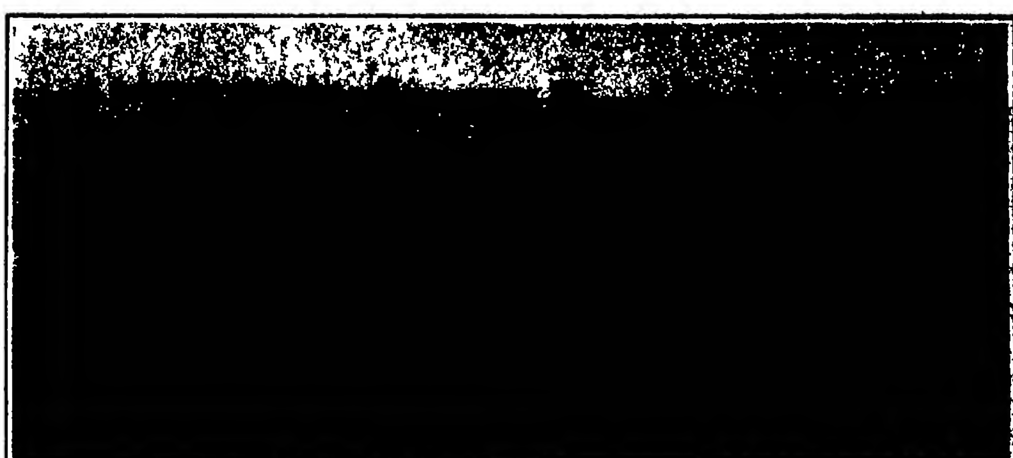
Little has been written on the Great Wall in a comprehensive way, says Mr Clapp, and for that reason many misapprehensions exist as to its position, extent, preservation, history, etc. In the first place, one must not suppose that it is a structural unit, or that it was constructed all at one time. A number of separate walls, dating back several centuries, had been constructed bordering on the domains of the savage Hsiung-nu before the reign of the so-called "First Emperor," Hwang-ti, who buried alive hundreds of scholars and burned nearly all the books of the Empire. One of the separate walls, for instance, was built as early as the year 469 B. C. by Prince Chung-shan. The "First Emperor" (246-210 B C) in reality united and strengthened existing walls, and there is no doubt that during the past 2200 years the Chinese have built various Great Walls of as many varieties of construction. Some repairs were made as late as the beginning of the Ching (Manchu) Dynasty, since when no attempt has been made to keep the wall in repair.

The height of the Great Wall averages 22 feet, but varies from 20 to 50 feet, the base is 15 to 25 feet thick, and the top 12 feet or more, in places the wall is solid and level enough to support an automobile; but in others it consists of massive flights of steps.

The entire eastern section and that at Nankow Pass are built of masonry and bricks and are mostly well preserved, but further west the wall is much less substantial, has fallen in many places into decay, and in Kansu Province resembles a large mud bank. Certain indications found in the brick work, in legends and in tablets, are that in some parts the towers were built first and then the walls constructed between them.

In many parts of Shensi and Shansi provinces the character of the loess formation is such that it could be cut out into the form of a wall—which plan in reality was very effective. The material was simply split down vertically and then faced with stone. In other places the wall had to be built up of loess, above the plain. A wooden framework was constructed, the loess was thrown in, watered, and rammed; then the framework was removed, leaving the wall fully constructed. Even where built of loess the wall, in spite of long neglect, is generally distinctly traceable between the towers.

The Great Wall at its best can be judged from the section at Nankow Pass, which is in an excellent state of preservation, and is typical of the entire eastern arm. At Nankow Pass, and generally in the mountains, the wall is composed of granite blocks for a height of 25 feet above its base, the blocks being five feet long and one foot square, set in two parallel furrows cut 25 feet apart in the solid rock. The blocks, some as much as 14 feet long by 3, or 4 feet thick, were evidently hauled long distances from the quarries. The upper part of the

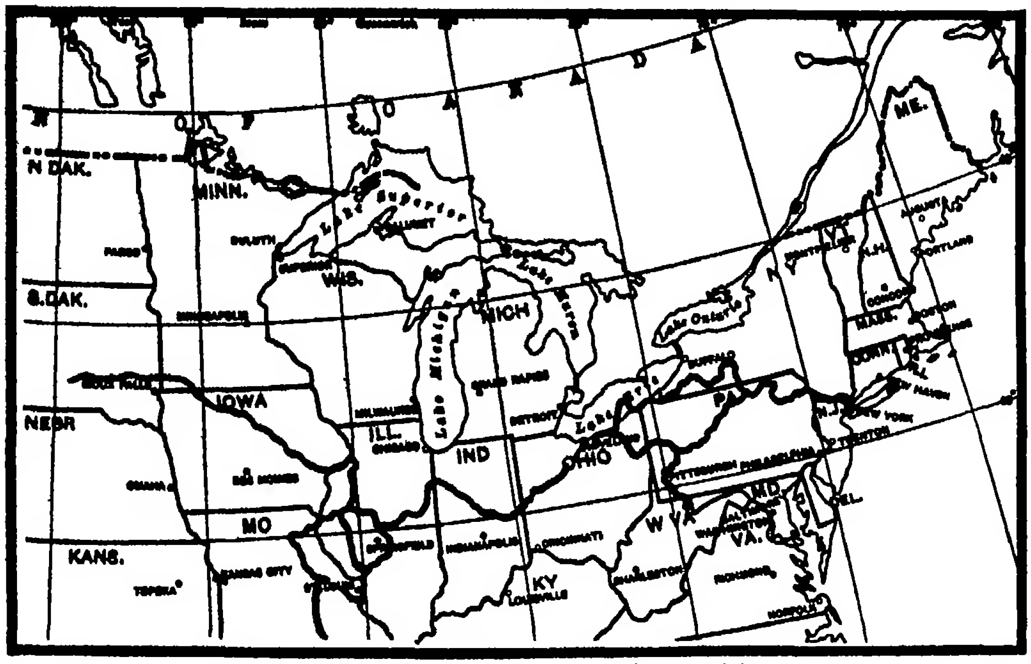


Towers of the "First Frontier Wall" being gradually buried by the sands of the Ordos Desert

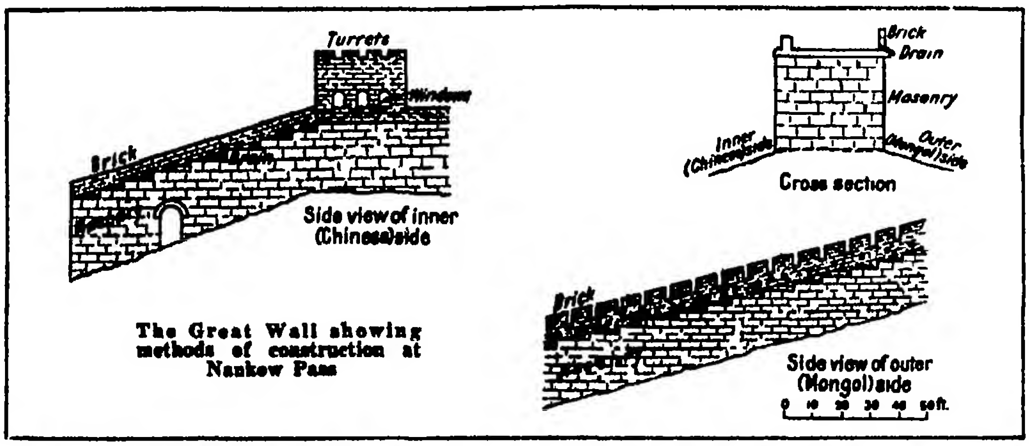
wall is composed of bricks, some as much as 22 inches long, others 14 inches square and 3½ inches thick and of better quality than most brick made at the present day. The mortar that holds the bricks together is better than the Chinese can make at the present time.

At intervals of a few hundred feet are doorways leading to the inner (Chinese) side and steps leading to the top, so that soldiers could easily ascend to defend it against invasion. Every few hundred feet are watchtowers, formerly used as sentry stations, 30 to 40 feet square and 40 feet or so in height. The top of the wall in the Nankow section is a roadway 14 feet wide. At intervals of 50 to 100 feet are stone drains to allow rain water to run off the roadway, and the foresight thus shown has helped its preservation. The engineers who laid out the wall seem to have generally selected strong lines of defense, such as mountain crests and narrow gorges. Huge permanent garrisons were quartered in fortified camps behind the wall.

The Great Wall is no longer needed, it has served its purpose. The protection it afforded against Mongol and Hun consisted not only in its substantial masonry or piled loess, but in its wonderful continuity, in the alertness of its defenders, in its system of watchtowers and signals and above all in its expression, concrete and symbolic, as a barrier boundary beyond which no invader could come without incurring the wrath and vengeance of an infuriated people. One foe alone has not been stopped by the Great Wall. This is the sand of the Desert of Gobi that is driven by wind and climatic conditions southward mile after mile, year after year. Owing to the winds and the deforestation of the country, which may be called China's most serious mistake, the desert will continue to move southward and in a few thousand years render even larger portions of Shensi uninhabitable. Is there no remedy for this condition? Mr. Clapp believes there is. A new Great Wall should be constructed, not of brick or stone or earth guarded by soldiers, but a forest barrier guarded by expert foresters. A forest one mile wide along the northern border of the country would probably suffice; in Shensi, at any rate, the project appears to be feasible. Irrigation, too, would reclaim portions of the desert.



The Great Wall projected on a map of the United States



The Great Wall showing methods of construction at Nankow Pass


The inner branch of the Great Wall at Nankow Pass

Vitamine Food Tablets

IN the conservation of food it is necessary to remove the vitamines from certain staple products. Wheat flour cannot be conserved for a long period unless it is bolted, thereby removing all of the vitamines. Cane sugar is perfectly stable, but this stability is due to the fact that any proteins or vitamines that may have been in the cane juice has been removed. The hydrogenated fats are about the most stable of the fats, and yet their vitamine content is zero. It is, therefore, highly desirable to have vitamine preparations to add to such preserved foods as these, to complete the diet.

There are many families who do not, under the present system, receive sufficient vitamines in their food. Therefore some addition seems necessary, but this is clearly considered as an addition and not as a substitute for anything. These additions may be in the form of dehydrated products. Many of the vegetables and fruits may be dehydrated and consumed in a form which will furnish the consumer with considerable vitamine and yet not necessitate a change in the methods of preparation of foods by the family. Those dehydrated vegetables may contain vitamines A and B and dehydrated fruits may under certain circumstances contain in addition some vitamine C. The dietary habits of various persons, however, form an obstacle to the consumption of sufficient vitamines. There are also many persons who can relish fresh foods (spinach for instance) when they cannot stomach the same foods dried. The peel of citrus fruits, and some other fruits, is very rich in vitamines, yet no one eats them. For those persons who do not relish certain vitamine-containing vegetable products the use of tablets containing these products, which may be swallowed whole, seems desirable. Orange peelings ground in a meat chopper, dried and ground in a coffee mill may be made into tablets by the addition of dehydrated orange juice acting as a binder. Such tablets contain vitamines A, B and C. Ground spinach may be similarly made into concentrated vitamine tablets with orange juice.—*Notes from an article by Dr. J. F. McClendon in Science for October 28, 1921.*

Iron for Use in the Manufacture of Car Wheels

THE investigation which has been conducted at the Bureau of Standards for some time past on the stresses in iron and steel car wheels resulting from heating the rim of the wheel has led to some important results. Among other things, it is believed that the performance of these wheels may be further improved by studying thoroughly the metal out of which the wheel is made. In line with this policy, an investigation has been inaugurated to study the relation between the mechanical composition and the physical properties of cast iron of the type used in manufacturing chilled iron wheels. In the preliminary work particular attention is to be paid to the sulfur and phosphorus content of the iron. It is planned to make the iron in a high frequency electric furnace which will permit a very close regulation to any desired composition. It is then expected to conduct the following tests on the cast material: Transverse, tensile, impact, hardness, and wear. The depth of the chill of the chilled specimens will also be noted.

When Tables Tip

The Latest Investigations Into the Externalization of the Psychic Power

By Hereward Carrington, Ph.D.

WHETHER the skeptic likes it or not, we seem to have pretty definite evidence that the psychic force, whatever its nature, is on occasion able to step out of the subjective realm of hallucinations, mediumistic trances, automatic writing and the like, and actually create material effects in the material world about us Tables do move, sounds are produced, something which can be felt and photographed and whose continuity can be broken by passing through it is extruded from the medium's person. Leaving behind him the purely subjective and mental phenomena of the psychic which one of the editors discussed in our April issue, Dr Carrington in the present article takes up these external, objective manifestations He catalogs them briefly, tells what has been done in the way of scientific investigation, indicates just what progress we have made in the direction of proving their nature and their cause, and puts forward some interesting suggestions for further procedure in this direction As further progress is made, we shall of course return to the subject of psychic science; but the present article completes the series of which it is a part, and which has been running through our issues of the past six months We believe we have formulated the present state of this science as well as it can at this time be formulated —THE EDITOR

PSYCHIC research may be defined as the scientific investigation of a mass of apparent phenomena which do not fall under any of the orthodox sciences. These phenomena many of us believe to exist, and hence to form the basis of a new science In any event, science and its methods may be applied to their investigation, just as to that of any other phenomena

Before going further, a word of caution is necessary Because *certain facts may* be proved, it *does not follow* that any particular interpretation of these facts is verified. Many European savants are convinced of the reality of so-called "spiritualistic" phenomena yet they are in no sense spiritualists. The phenomena may be due to unknown powers of the most material sort within our minds and bodies. Let us establish the facts first of all, and apply theories afterwards

The Editor has already outlined in a signed article the theory, which we must all in some measure accept, that there is a continuous waking self in all of us, capable of manifesting independently of the normal consciousness. And where there at first appears to be no particular relationship between telepathy, apparitions, dreams, crystal gazing, warnings, mysterious touches, table-tippings, hysteria, genius, unaccounted emotional depressions, automatic writing, etc., etc yet this theory shows that a connection does exist between them They are all expressions of the activity of the subconscious mind—the "subliminal consciousness."

Any message arising from the subconscious mind is expressed in symbolic form through some sensory channel Usually these messages take the form of mere recollection, but if one be imaginative, hysterical, a poet, a genius, a medium, or unbalanced—why then such a message would probably assume the proportions of a psychic phenomenon It may be visual It may be auditory, it may express itself in motor form, in which event the subject is unaccountably impelled to some certain action. All these are but expressions of the subconscious message We do not in these cases assume that a spirit has pointed out the hiding place of the missing papers, or has whispered this knowledge in our ears or engineered the vision of it in the dream or in the crystal ball We merely assume that the subconscious mind has expressed its hidden knowledge through one or another sensory channel

When the information conveyed cannot reasonably be supposed to have originated within the subject's own subconsciousness we must seek elsewhere for explanation. If a medium tells you "Your cousin has just been run over and suffered a broken leg he is now in Flower Hospital," the question is, assuming this information to be correct, how did the medium's mind come in possession of it?

In a great number of cases, information apparently has been given either with or without a medium which could not possibly have got into the mind of the medium or into the subconscious mind of the recipient in any normal manner In the vast majority of cases there is no doubt that it was acquired through telepathy—the transmission of thought direct from one mind to another, without the aid of the senses As to the precise nature of telepathy there is as yet no certainty It may or may not be waves that travel from brain to brain Whatever its ultimate explanation, it is certain that some form of telepathy must exist and that it is an explanatory hypothesis of great value enabling us to account for many phenomena for which we should otherwise have no rational explanation

Thus, when the *Society for Psychical Research* began its investigations, it was observed that the large majority of apparitions, so-called, coincided with the death of the person represented by the phantasmal figure. *Many thousands of cases of this character* are recorded. Need we suppose that the "spirit" of the dead man was actually present and manifesting itself at such a time? By no means the modern theory of telepathy enables us to account for such manifestations in a rational manner, and in conformity with the traditions of science—once the reality of telepathy be granted. For we need only suppose that a telepathic impulse was conveyed to the recipient's mind from the mind of the dying person, and then externalised as a hallucination

In addition to apparitions of the dying, there are rarer cases of apparitions of the living or of the dead. These *latter* occur some days, weeks, or even years after the death of the person they represent, and, if they are attached to a certain house or locality, constitute phenomena typical of so-called "haunted houses." Several theories have been advanced to account for these on a subjective basis, and it may even be said that there is a considerable mass of respectable testimony in favor of the view that in certain instances there are involved physical, outstanding entities, more or less corresponding to the popular conception of a ghost, since these phantom forms have apparently moved objects, closed and opened doors, snuffed candles, etc —and hallucinations cannot do that! But, of course, the vast majority of cases of this character represent mere hallucinations—perhaps entirely subjective, perhaps telepathically induced

It is impossible to particularize further here in this direction We must turn our attention now to the physical phenomena of psychic origin—those which affect the material world in which we live, and which may seem to the reader more nearly tangible and intelligible. When we deal with a new force, it is more readily understood than a purely mental phenomenon, since it is more nearly in line with every-day experience A brief summary of these psychic manifestations will accordingly be attempted in what follows.

First of all it must be remembered, as before, that when Ouija moves, or tables tip, there can be no doubt at all that in a vast majority of cases the sitters unconsciously push them. So far there is nothing mysterious at all everything is explained on purely physiological grounds.

But that is not the whole story In many cases an actual *force* seems to be generated—a force or energy which seems to emanate from the fingers of the sitters, and, particularly the medium, and "charge" the table or instrument being employed. When this has taken place the table rises completely from the floor—all four legs—and we witness a complete "levitation." What is the nature of this energy: whence comes it, and how is it applied in order to lift the table in question?

A good deal of study has been devoted to this problem by various psychic students. For our present purposes I shall summarise the investigations and conclusions of W J Crawford, a lecturer on mechanical engineering in Belfast, who has had the good fortune to encounter a young non-professional medium, apparently possessing great power, and to study the phenomena over a number of years by mechanical methods of investigation. This is what be found

The medium weighed normally about 180 pounds. The table to be lifted weighed about 10 pounds. The medium, chair and all, was placed upon the platform of a weighing machine. Her weight was noted. The seance then began and the table was "levitated." During the levitation, it was found that the medium increased in weight by 10 pounds—that is, the precise weight of the table This would, of course, have occurred had she lifted it with her hands, in the usual manner, but it was completely demonstrated that no *physical* connection of any sort existed, connecting the medium's body and the table.

Yet the medium increased by the weight of the table! And the table crashed if anyone walked between her and it! Dr Crawford argued—very rightly, I think—that this shows some sort of *invisible* connection between the two. What was the nature of this connection, and how was it applied?

Dr. Crawford provided himself with a spring balance When the table was in the air he placed this in turn under all four legs of the table. No pressure was recorded He then placed it on the floor under the center of the table. No pressure was recorded. When, however, the platform attached to the scale was raised several inches from the floor a sudden pressure was exerted upon it. That is to say, although nothing visible could be detected between the top of the balance platform and the under surface of the table, nevertheless some invisible something now resting upon the balance was supporting the table. And this beam or column was also somehow connected with the body of the medium

To make a long story short, Dr Crawford worked out—and conducted a number of ingenious tests which seem to prove—his "cantilever theory" of levitation. It is that there issues from the medium's body a column of energy, which extends outward, under the table, and then rises until it comes into contact with and grips the center of the under surface of the table. It is this which lifts the table When the platform of the balance is so placed that the lowest point of this invisible column rests upon it, the reaction of the table is naturally supported by the balance, and the weight of the table thus registered. When this is not the case, the weight of the table reacts directly upon the body of the medium, as shown by the scales upon which the medium is seated.

This "psychic arm' for years quite invisible was finally brought into visibility, in a red light, so that it could be seen, and was even photographed Crawford goes further He describes the gradual evolution of a semi-solid substance, from complete invisibility, going on before his eyes—a substance cold, slimy, protoplasmic, and reptilian to the touch. It was undoubtedly *physiological* in nature, but apparently possessed of attributes differing from any normal physiological activities, tissues or organs of the body

Fortunately, this process of the exudation of a form of "plasma" has been observed in the cases of several other mediums, for a number of years past, and there can hardly remain any doubt that some such extraordinary phenomenon takes place. Dr. von Schrenck-Nötzing, Mme Bisson and Dr Geley, particularly, have studied a certain young woman, Eva Carrière, who extrudes or "materializes" this plasmic substance from various parts of her body, and in her case this has not only been seen, touched and photographed, but motion pictures have been taken of the entire process, and a microscopic analysis has been made of certain small portions of the substances which remained behind, after it had receded into the body of the medium! These micro-photographs show us that we are beholding a curious hodge-podge of apparently living matter, thrown together helter-skelter, and more or less resembling a tumor-growth in its peculiarities.

All this in itself is curious enough. But more strange things are to follow! This living substance, which has been *seen to issue, visibly,* from the medium's body, then begins to take shape, and rapidly forms itself, or is molded, into hands, faces and bits of bodies which last a few moments in vivid life-like reality, and then instantaneously vanish back into the medium's body! These hands have been touched, and it is said that the faces, while they last, are extremely life-like.

These are, I frankly admit, perfectly incredible mani-

(Continued on page 434)

Stretching the Five-Foot Shelf

An Invention That May Reduce the Size of Our Books to a Fraction of Their Present Bulk

By S. R. Winters

VOLUMINOUS periodicals, involving the expenditure of billions of dollars annually in printing and acres and acres of space in which to store, as embodied in the present art of printing may be revolutionized by an invention of Rear Admiral Bradley A. Fiske of Washington, D C Labeled as the "Fiske Reading Machine," a patent has been granted the inventor The device is simplicity and compactness personified, lending itself to easy carriage in one's coat pocket.

The instrument, consisting of a tiny lens and a small roller for operating this eyepiece up and down a vertical column of reading-matter, is a means by which ordinary typewritten copy, when photographically reduced to one-hundredth of the space originally occupied, can be read with quite the facility that the impression of conventional printing type is now revealed to the unaided eye The device is only six and one-quarter inches long, one and seven-eighths inches wide, one-quarter of an inch thick, and weighs five and one-half ounces.

More about the details of the machine, which consists of four parts There is an extremely light frame, composed of aluminum. A strip of paper is a carriage for the photographed lettering, which lies in a longitudinal groove in the frame. A tiny lens, capable of magnifying the characters ten times, brings the lettering into prominent review A roller, really the only mechanical part of the contrivance, serves the purpose of moving the strip of paper along a groove in front of the lens. The forefinger of the hand holding the frame acts in this capacity

The lettering, reduced ten times just as the lens has a magnification of equal capacity, is imprinted on a narrow strip of paper which may be moved at will in front of the lens at a fixed distance therefrom. These tiny representations or characters are printed from a copper block on which have been photo-engraved, on a reduced scale, common typewritten matter The process operates in the absence of type and involves no typesetting. However, this novel system renders it possible to photo-engrave books already printed and likewise publish reduced copies at a nominal expense for use in the "Fiske Reading Machine."

Answering frequent inquiries to the effect, "Does the use of this machine tire your eyes," Admiral Fiske likens the effect thus expended to that of reading ordinary lettering with the unaided eye. The characters appear plainly by reason of the lens magnifying them to the same extent that the photographic process reduces them. The structural features of the instrument make it imperative that the characters remain at a uniformly correct distance from the eye. Admiral Fiske, in answering the suggestions of the possibility of the instrument causing jaded eyes, throws out the reminder that engravers toil incessantly at their occupations which is of striking similarity to reading by this machine.

When reading the operator holds the device in front of either eye, propelling the paper in such a manner that it facilitates reading of the representations as is characteristic of reading a book or newspaper A blinder, attached to the machine, can be operated in obstructing the view of the unused eye. The strain of employing both eyes is thus obviated. Unless the light is dim, one eye is adequate to the needs of reading. The use of both eyes will doubtless involve the construction of a unit of the reading machine more elaborate than the present design

The dispatch with which one can read when using the "Fiske Reading Machine" is remarkable At a single glance through the lens one hundred and twenty words are revealed to view Admiral Fiske, in demonstrating his invention to the writer, read aloud at a rate of 280 words a minute. The writer, in turn, in giving the machine a trial demonstration read, in silence, 287 words a minute by actual count. The strip of paper containing the lettering is chockful of words —10,000 on each side, to be exact. Thus, five such strips, with characters on both sides, would contain 100,000 words, in excess of the number possessed by an ordinary book or magazine More graphically expressed, perhaps, is the comparison between a package of these strips and the cumbersomeness of a standard dictionary The latter contains approximately 2,850 pages, weighing about 20 pounds, while 475 strips, two inches wide and nine inches long, could incorporate the contents of a bulky dictionary The weight of these strips of paper would be only two and a half pounds or about one-eighth of that of a standard dictionary

Literally, tons of books are annually published in the United States as reference guides with no object of being read. The "Fiske Reading Machine' would cut the mounting costs of paper and printing involved in this task of magnitude Similarly, millions of dollars are spent by the Federal government in the publication of bulletins that are never read, and their storage exacts a further toll in the form of valuable space The invention being described would authorize drastic economies in these instances. Other possibilities outlined in behalf of the 'Fiske Reading Machine" were sketched for the writer of this article by the inventor as follows

1 The cost of manufacturing books, magazines, weeklies and perhaps newspapers will be so reduced that 10,000 copies of one of average size containing about 100,000 words, can be manufactured and sold to a publisher for four cents each If 100,000 copies are issued, they can be sold of course, at a price much less.

2 Since the best quality of paper must be used books, magazines and newspapers used in reading machines will last indefinitely At present they begin to get discolored and to crumble in a few years.

3 The amount of paper needed for printing any number of words will be diminished to about one-sixtieth of what is needed now

4. An ordinary book, magazine or weekly as reduced can be sent by mail for one cent singly

5 The work of mailing books magazines and weeklies will be enormously reduced and the transmission of mail by airplane much facilitated

6 The space needed for keeping books, magazines and documents will be enormously diminished

7 The cost of manufacturing magazines, weeklies and newspapers will be so greatly reduced that in all probability they can be given away, assuming that advertisers will continue to pay as at present

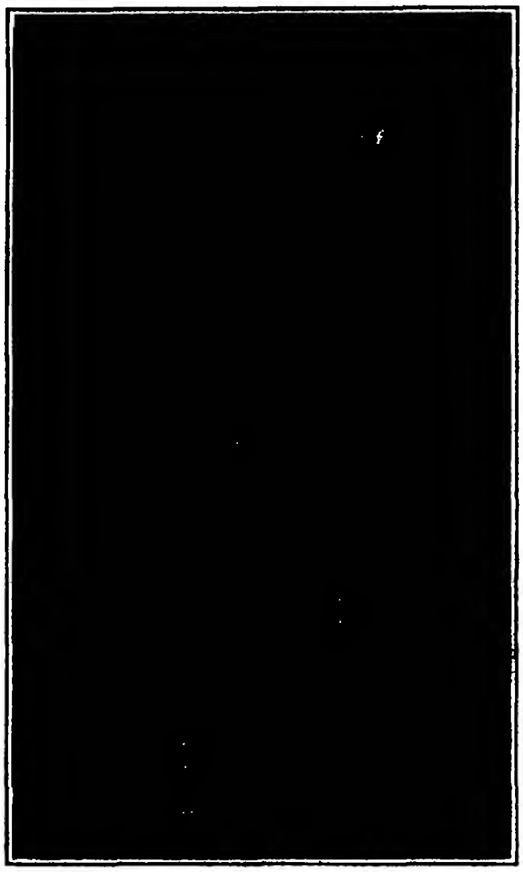
8 Smaller presses will suffice and therefore less capital will be required.

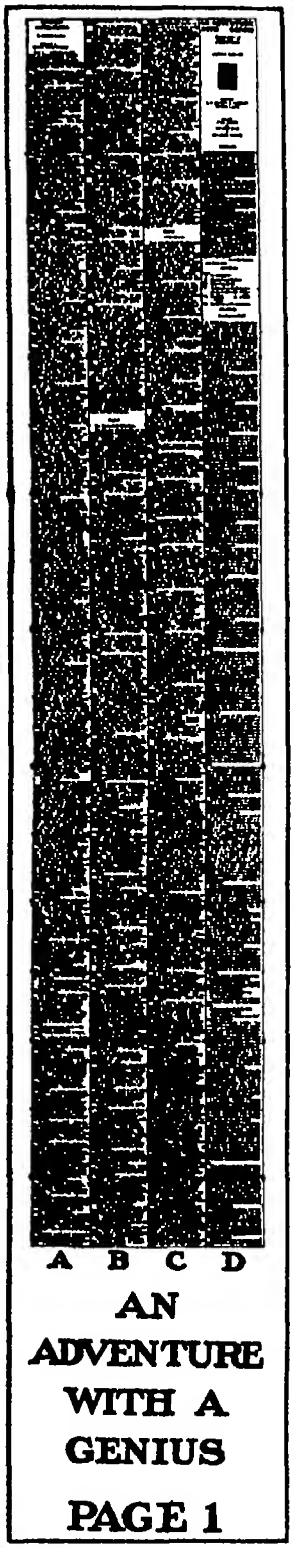
9 Books of reference such as encyclopedias and dictionaries standard books like the Bible and the works of Shakespeare and other pre-eminent authors, can be sold for prices much less than their present prices.

10 Eye glasses and spectacles will not be required for reading.

11 The diffusion of knowledge will be greatly facilitated because even the poorest people will be able to buy the most instructive and entertaining works.

The "Fiske Reading Machine' is the product of two years of creative effort of the inventor His original attempt to devise a machine for easy reading is apparently fruitful of achievement Somewhat of a coincidence may it not be considered that this invention of revolutionary possibilities has been introduced at a time when a scientific world is discussing a book "Invention the Master Key to Progress also a product of Rear Admiral Bradley A Fiske? His creative genius, so wonderfully productive while in the service of the Navy, is not inactive now that his retirement is a fact





Above: Rear Admiral Fiske demonstrating his reading machine; the blinder is seen since only one eye is being used. *Below* A close view of the reading machine, with strip of reading matter in position *Right:* A sample page of reading matter, reproduced in its actual size. This page contains 10,000 words, more than 25 times as many as are found on the average book-page

The new technique of reading suggested by Rear Admiral Fiske

Aluminum in German Cars

ONE of the most remarkable features at the recent Berlin Show was the rapidly increasing use of aluminium and aluminium alloys not only for cylinder pistons and crank cases but for other parts as well the manufacture of which has become an engineering branch of its own in which some of the late aircraft makers, the Zeppelin works at Staaken among the rest, are taking a leading part The possibility of using aluminium even for the manufacture of parts submitted to heavy strain mainly depends on the use of an alloy with silicon, raising the coefficient of expansion to a figure close to that of steel and iron Similarly to the use of armored concrete, some sort of "armored" aluminium, a most resisting and remarkably light material, is now obtained by embedding in the aluminium mass thin steel portions intended to transmit any tensile stresses, whereas the surrounding aluminium is relied upon to deal with compressive stresses.

The Treatment of Fuels by Direct Flame

Coking Coal and Gasifying Liquid Fuels Right in the Fire, Without Danger of Burning Them

By F. Frank

COMBUSTION of fuel is the principal source of energy in almost every industry. The development of this energy is the special task of modern chemistry, the foundation of which was laid by the correct understanding of the phenomenon of combustion.

Any process of combustion requires two substances: one which burns, and one which supports combustion. The latter substance ordinarily is oxygen from the air.

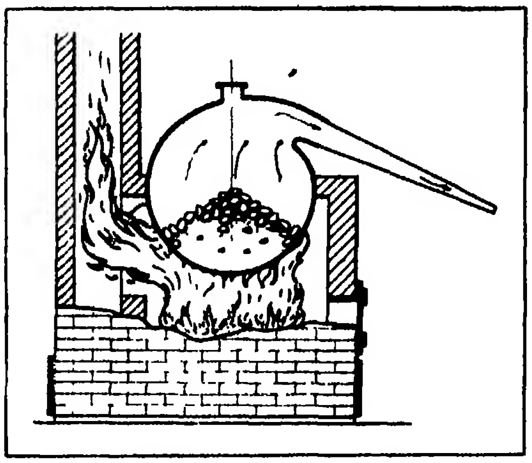


Fig. 1: Diagrammatic scheme of the conventional retort, in which heat is applied to the outside of the retort walls, and comes to the charge only by penetrating these walls

In every five cubic feet of air there is contained approximately one cubic foot of oxygen, which is readily available for combustion. Without oxygen a material cannot burn. Unless air is supplied to an ordinary furnace the fire will go out. The term fire, as used in the industries, describes the burning of fuel under evolution of light and heat. The zone in which this evolution of light and heat takes place is commonly called a flame.

In a retort heated externally in the old-fashioned way (Fig. 1), fuel is burned in the fire-box under the retort in order to heat the material within the retort. The smokestack removes the products of combustion evolved in the fire-box, and draws a continuous supply of fresh air through the fuel bed. The products of combustion carry away through the stack a great deal of heat which must be considered as lost, for it is not employed in heating the material in the retort. The greater this loss, the lower the efficiency of the furnace. The fire heats first the material of which the retort is made, which then transmits part of the heat which it receives from the fire-box to its contained material. Part of the heat evolved in the fire-box is lost through radiation from that portion of the retort not inclosed in the fire-box and another part is lost through radiation from the walls or brick work of the furnace.

Supposing now that the material contained in the retort is coal and that it is desired to coke this coal by heating it to the temperature necessary to drive off all of its moisture and volatile matter. First, a fire is started under the retort by igniting some fuel and the coal is gradually heated through the walls of the retort. In other words, the walls of the retort form a barrier between the coal and the fire. If this barrier were removed or even only broken, the coal itself would fall into the flames or be set afire by them. The walls of the retort transmit most of their heat to the nearest layer of coal, and throughout the entire operation this layer of material nearest to the walls will attain a higher temperature than the part of the charge further away from the walls. Long after the nearest layer has been converted from coal into coke the more distant layers will still be coal and relatively cold. Coke is an insulating material—that is to say, it is not a good conductor of heat. After the first layer of coke has been formed, a condition has been reached where the remaining coal is heated from the outside of the retort through the walls of the retort and through an insulating layer of coke.

The highest efficiency of heat transfer and the greatest utilization of the physico-chemical properties of a flame can be reached only by bringing the material to be heated into direct, actual, intimate contact with the flame. Where the heating of non-burnable materials is involved, the direct application of a flame offers no difficulties. The process of heating combustible and highly inflammable substances, such as coal, petroleum, alcohol, etc., with direct live flames, without setting them afire and burning them, necessitated for its solution years of research work. After many difficult experiments it has been solved in an extremely simple and practical manner.

Fig. 2 illustrates its application to coal contained in an iron retort similar to Fig. 1. The interior firing makes both stack and furnace unnecessary. In order to minimize losses by radiation, the outside of the retort is covered with an insulating material such as asbestos, and the inside is lined with a refractory material, such as fire-brick. The flame in this case is produced by burning fuel gas and air which have been premixed in such proportions that there is present in the mixture just sufficient oxygen to burn the fuel gas. This result is obtained by very simple mechanical mixing devices. The combustible mixture of gas and air is delivered to the burner at such a high velocity that the flame cannot burn back into the delivery pipe. As there is just sufficient oxygen present in the gaseous mixture to support the combustion of the fuel gas, the coal in the retort cannot burn, without oxygen a material cannot burn regardless of the temperature to which it is subjected, even though this temperature be produced by the direct application of a live flame.

The flame temperature can be predetermined and regulated according to the chemical composition of the mixture from which the flame is produced. The character of the flame may be neutral, oxidizing, or reducing, depending upon the desired result. The flame comes into direct, intimate contact with the material, and it can be said that the material itself acts like a breaker in the path of the flame. The flame penetrates, and burns within, the voids of the entire mass of coal, without igniting or burning the coal itself, and without burning the gases and vapors given off by the coal during the heating operation. The flame and the products of combustion fill the voids of the charge and surround each individual chunk of coal from all sides and completely envelop it. The coal is decomposed by the heat into coke and fixed fuel gases and vapors, which, after leaving the retort, are condensed into coal tar. Aside from the advantages already stated, important additional savings are obtained in cutting down the time needed for the heating operation.

When it is desired to gasify completely all volatile matter of the coal as well as all fixed carbon, a furnace is used, into which steam may be introduced, which

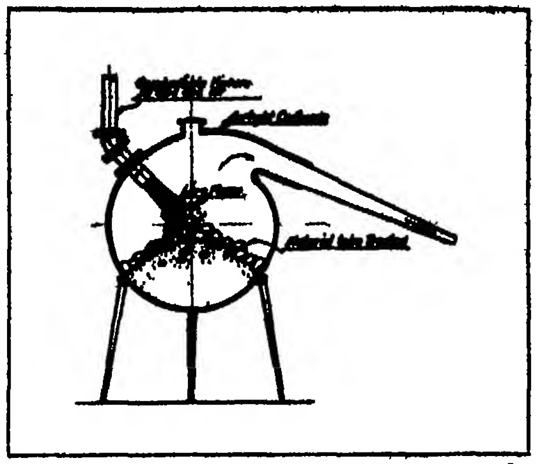
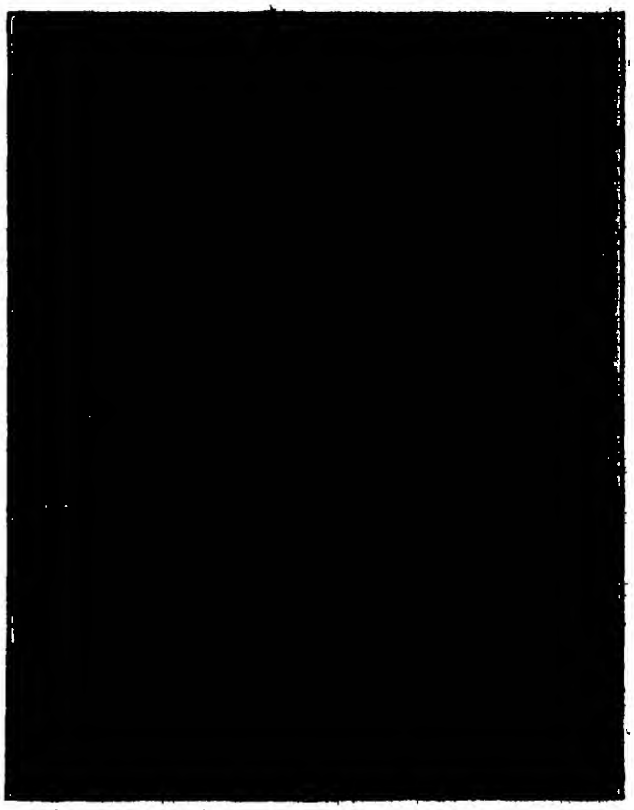


Fig. 2: Diagrammatic representation of retort of the new style, in which flame actually comes in contact with the charge, even though this be combustible, without burning it

is decomposed into hydrogen and oxygen, and the fixed carbon is converted by the liberated oxygen into carbon monoxide. Ash remains as a sole residue. This apparatus can also be used for the complete gasification of solid and liquid fuels at the same time. Coal or coke and oil or tar are fed in continuously, together with steam, and are subjected to the direct action of live flames at their highest calorific intensity. The resulting gas will be a mixture of coal gas, oil gas, and water gas, depending on the relative quantities of solid and liquid fuels used.

The stationary gasification furnace for liquid fuels, in spite of its small size, has delivered in actual operation in the plant at Oakland, Calif., at the rate of over 200,000 cubic feet of fuel gas per hour made from ordinary fuel oil and steam. Live flames play directly upon a refractory bed of broken fire-brick and form flame screens through which atomized oil and steam are drawn. The atomized oil in practice is completely vaporized before it reaches the flame zone, and is decomposed therein into fixed fuel gases and residual carbon, which in turn is subjected to a vigorous water-gas reaction with the steam. The labor cost in connection with this furnace is negligible. Gas has been made by this new process from about the same amount of oil as is required by many eastern coal-gas plants for the mere purpose of carburetting or enriching the coal gas. This gas is suitable for city distribution, as it possesses all properties required for heating and illuminating purposes. It has the added advantage that it does not contain naphthalene or sulfur compounds. The sulfur in the oil is converted into sulfur dioxide, which is absorbed by the water in the scrubber. The chemical analysis of the gas shows a nitrogen content which in certain cases may be as high as 50 per cent, without, however, lowering the fuel value of the gas.



Stationary gasification furnace of the internal type for liquid fuels

The reactions, which are set up between steam and oil vapors at the high temperatures prevailing in the flame screens are not yet definitely understood; and adequate means for the correct chemical identification and analysis of the components of gas made at these high temperatures have not been developed to establish a basis for the comparison of the fuel gases made by this and other processes. For practical purposes the chemical analysis of a fixed gas is immaterial as long as the gas is of the desired heat value. It is foreseen that a considerable discussion among chemists will arise over this question.

The Heavens in June, 1922

The Recent Reports of Shifting Latitudes, and What the Astronomer Makes of Them

By Prof. Henry Norris Russell, Ph.D

ONE of the most interesting of recent astronomical investigations—told at the meeting of the American Astronomical Society last December, but not yet published in full—deals with the apparently unattractive topic of measurement of latitude.

Everyone knows that the latitude of an observer—whether on a ship at sea or at a fixed observatory—is determined by observations of stars. If we could find a star which passed directly overhead (through our zenith), our latitude—or roughly, our distance from the equator on the earth—would be equal to this star's declination, or distance in degrees from equator in the heavens. Any other star will do if we can find how far it is from the zenith when it crosses the meridian, and if we know how far it is from the celestial equator

Until about 30 years ago it was believed that the latitude of any point of observation, fixed on the earth's surface, was always the same. But as observations became more precise, it was found that there was actually a slight *variation in latitude*—amounting to but a few tenths of a second in all, but unquestionably real. This was first noticed in Germany, and confirmed shortly afterwards by observations in Hawaii by an expedition sent for the purpose. These showed that when the latitude of the European station increased that of the Hawaiian post decreased, and hence that the earth's pole was moving, rather than either station. Before long the problem was fully solved, mainly by the labors of the American Chandler, who found that the motion of the pole could be represented as follows:

How the Pole Behaves

Starting with the average position of the pole—a fixed point—we may imagine another point moving about this in a circle, at a distance of about 15 feet, and with a period of 14 months, while a second point moves about the first moving point in an elongated ellipse once a year, never getting more than about 12 feet from it. This second point gives the position of the "instantaneous pole"—that is, the spot on the earth's surface about which it turns on any given day The combination of these two influences may change the distance of an observer from the pole by as much as 25 feet each way, producing a variation in latitude of about half a second of arc. Both terms in the motion were promptly explained theoretically—the 14-month term arising from a natural tendency of the spheroidal planet to wobble a little, and the annual term coming from changes in the ocean currents, etc., with the seasons The latter term, in particular, is not quite the same from year to year, and it became evident that, if the full value of modern instruments was to be realized, it would be necessary to keep track of its amount by special observations.

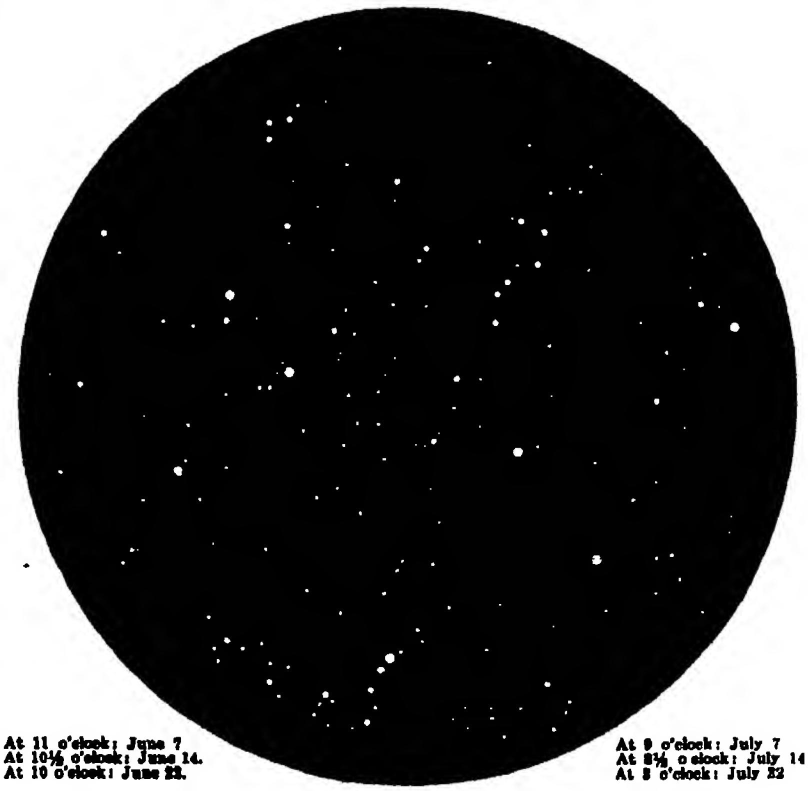
An international arrangement was therefore made, by which five observatories were set up on the parallel of 39° 8' north latitude, and observations of the latitude were made on every clear night with zenith telescopes—instruments especially designed to give results of the highest attainable accuracy One of these stations was in Sardinia, the next, counting eastward, in Turkestan, the third in Japan, the fourth at Ukiah, Calif., and the fifth at Gaithersburg, Md. Among them they encircle the pole on all sides, so that it cannot move in any direction without approaching at least one of them, and receding from some other, hence its drift is doubly checked.

Some 20 years' work at these stations has made it possible to follow the periodic motions of the pole with great accuracy. But all this is an old story, the new part follows. It was noted a few years ago that, in addition to the periodic fluctuations, the latitude of Ukiah showed a steady tendency to increase. A plot of the average values derived from the observations of one year after another (when corrected for the periodic changes) showed that the effect was unquestionably real—a steady shift of about 0.01" per year, and corresponding to an approach to the pole at the rate of one foot annually Certain geologists suggested that this might mean that this part of California was really moving northward—perhaps as a part of one of those great movements of the earth's crust which end in slipping along lines of fracture and thus cause great earthquakes like that of 1906. Ukiah is many miles from the particular fault-line along which the motion then occurred, but the suggestion was of great interest.

It has been carefully tested by Dr Lambert of the United States Coast and Geodetic Survey whose conclusions are those referred to at the beginning of the present paper Dr Lambert confirms the increase in the latitude of Ukiah, but finds that a similar increase, at an almost equal rate, appears in Maryland—where it certainly cannot be attributed to the California earthquake! Moreover, a similar northward drift is found in Europe and in Turkestan, while the Japanese station shows no change at all.

The Latest Puzzle

This looks queer at first sight. On the average, *all* the stations seem to be moving northward! The north pole cannot be moving toward them all at once. Is it possible that the earth is bulging out in the north, and its whole surface moving slowly in that direction? By no means, the physicist would answer—at least, by no means at present known to science. Fortunately, we do not have to invoke any such wild explanation The observed facts, reduced to their simplest terms, mean that, whereas the stars which are observed for latitude used to pass through certain definite points near the zenith, as seen from these stations 20 years ago, they now pass slightly but perceptibly to the south of these positions. This means either that the zenith (from which the positions are measured) has moved northward—or that the stars have moved southward. Now the stars on the observing list are actually in slow motion in the heavens, like all the other stars, but these "proper motions" have been allowed for in working out the observations. Before we can allow for them, however, we must measure them; and this can be done only by comparing modern observations with observations made many years ago (often a century) These older observations were not as accurate as can be made nowadays, and it may be that they were all, on the average, a little wrong. In this case the calculations based on them will fail to allow sufficiently for the slow southward average motion of the stars in the heavens, they will gradually shift to the southward of their calculated positions and the calculated latitudes will come out too far to the north



At 11 o'clock: June 7
At 10½ o'clock: June 14.
At 10 o'clock: June 22.

At 9 o'clock: July 7
At 8½ o'clock: July 14
At 8 o'clock: July 22

At 9½ o'clock: June 30.

The hours given are in Standard Time. When local summer time is in effect, they must be made one hour later: 12 o'clock on June 7 etc.

NIGHT SKY: JUNE AND JULY

We may therefore substitute for the improbable hypothesis of the bulging of the earth the very probable one that the old observations of the stars were slightly in error The correction to the proper motions which would remove the discrepancy is only about 0.005" per year, and for the most other purposes could be forgotten entirely

But when this correction has been made certain small shifts in the latitude of the various stations remain The European observatories show practically no change, but the American stations indicate a northward drift though at only one-half the rate previously suspected, while the Japanese station is moving southward at about the same rate

This set of changes can be explained by a real motion of the north pole in the direction of the American continent, which would take it away from Japan, and hardly change its distance from Europe at all From a careful discussion of the observations Dr Lambert finds that the pole, during the last 20 years, has been moving toward 77° west longitude at the rate of 0.005" per annum, or six inches a year on the earth's surface This motion is, of course, in addition to the periodic changes described earlier The 20 years of observation make its reality very probable, though not yet certain, but another decade or two will settle the question.

If this motion of the pole continued indefinitely, it would amount to about eight miles in a million years. Of course, we have no way at all of telling whether it has been uniform in the past, or will be in the future or whether it alters its rate and direction from century to century

It is perhaps worth pointing out explicitly that the motion indicated by observation will not do anything to explain the great Pleistocene glaciation of North America This was probably in full swing far less than a million years ago, when the pole if moving in the manner indicated, was only a couple of miles from its present location

The Planets

Mercury is in conjunction with the sun on the 18th, and is visible only at the beginning of the month, just after sunset, or at its close, in the dawn

Venus is an evening star in Gemini and Cancer very far north, and correspondingly conspicuous. Though not yet at her greatest elongation, she remains in prominent sight until 9.30 P M or later

Mars is in opposition on the 10th and is nearer and brighter than for a dozen years. His closest approach to the earth comes on the 18th at a distance of a little over 42 million miles. Unfortunately for northern observers, he is in declination 26 degrees south, and reaches an altitude of only 24 degrees on the meridian of New York This necessitates one's looking through twice as much air as would be in the way if the planet were higher in the sky Even with a small telescope, however, the principal surface markings may be seen if the air is steady

Jupiter and Saturn are in Virgo about 7 degrees apart, and are conspicuous from the twilight hours well on in the night Uranus is in quadrature on the 4th west of the sun in Aquarius, and observable in the morning. Neptune is in Cancer and is observable until about 10 P M in the middle of the month

The moon is in her first quarter at 1 P M on the 2nd, full at 11 A M on the 9th, in her last quarter at 7 A. M on the 17th, and new at 11 P M on the 24th She is nearest the earth on the 3rd, farthest off on the 16th, and in perigee again on the 28th During the month she passes near Saturn on the 3rd, Jupiter on the 4th, Mars on the 9th, Uranus on the 16th, Mercury on the 24th, Venus and Neptune on the 27th, and Saturn again on the morning of July 1

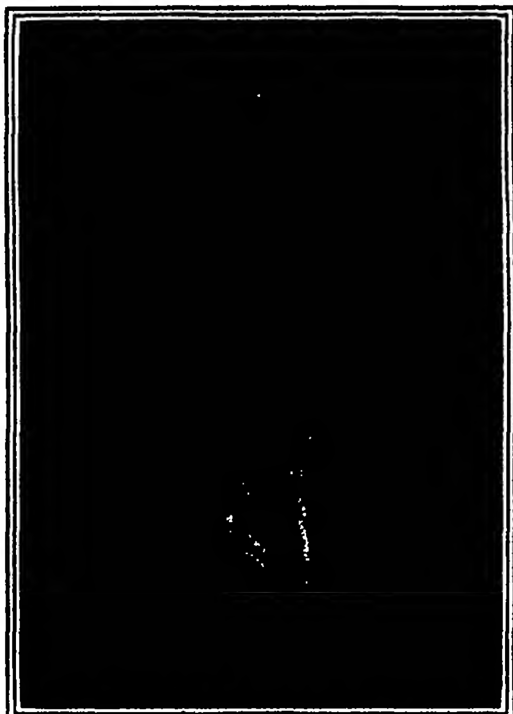
The Inside of the Question

"What Is the Matter with Our Colleges, and What Are They Going to Do About It?"

By Dean Ellery of Union College

MR EDISON has had his say, and what he has said has been sufficiently uncomplimentary to our colleges and the men whom they are turning out. Several correspondents have written at considerable length in reply to his remarks that appeared in our November issue, but most of them were too busy attacking his theory that a memory test will result in the selection of men of executive ability to pay any attention to what he said about the colleges Dean Ellery, however, whose portrait is shown, from long experience with the colleges and their problems naturally was more interested in this side of the inventor's views as reported by a member of our editorial staff We think he makes a very good case, and are glad indeed to give him the space in which to make it.—THE EDITOR.

GRANT for the sake of argument, that Mr Edison's criticisms of the American college undergraduate and of the American college as reported in this journal in the November issue, are based on fact They are not based on fact, but we will assume for the moment that they are, for even then, it is easy to show how unjustified they are For example, he complains that when the colleges graduate young men with a grade of 60, they are sending out into the world youngsters who have been right only 60 per cent of the time, and he states that no industry wants that kind of a man—one who is right only 60 per cent of the time The answer to that is easy The college undergraduate during all of his four years is constantly breaking new intellectual ground, he is meeting new subjects of thought, he is forming new mental concepts, he is exercising a new set of mental "muscles." Under those conditions mistakes are inevitable We do not remember how many tumbles we got when we first attempted to walk, without help we should have tumbled more. The finished pianist and violinist probably do not recall with how great labor they ran their first scale and how many errors they made in the performance of their first piece Mr Edison himself was probably right a good deal less than 60 per cent of the time when he first began work upon an incandescent electric light So, even if it were true that the numerical grades given to the college undergraduate represent the percentage of time that he is right, since he is constantly at work in fields which for him are new fields, if he is right 60 per cent of the time, he is a pretty good worker



There is no basis of comparison between the undergraduate and most men in professional or business life The man who is right all the time in life is likely to be the one who is doing one single thing in an office or a factory, who is meeting one set of conditions to which experience has accustomed him. He may be the man who is turning out day after day one small part of a complicated machine he may be a clerk who gathers and distributes stereotyped business information, he may be a so-called official who makes quotations upon the basis of a carefully worked-out scheme of costs, or he may even be a still higher executive who is "directing" the activities of men in set and definite channels. The number of men at the top of industrial organizations who are responsible for the successful conduct of work under new and always changing conditions is just as small, relatively as the number of college boys who rank high in their classes, and the reason is the same in both cases.

We could safely leave the argument here but it was all made on an assumption, that the grade of 60 in the work of a college course represents the fact that that individual was right 60 per cent of the time It represents nothing of the sort or rather it represents a good deal more These arithmetical grades given throughout the educational system, while apparently representing either the percentage of correct information which the student possesses or the number of times he has succeeded in the total number of efforts made, actually show where that individual stands in the scale of intelligence It is a comparative figure, it shows the relative position of undergraduates. It means that there are some undergraduates who are highly intelligent quick to learn exact in their work, correct in their conclusions indefatigable in their labor There are others who are not so gifted. If there were no colleges at all there would still be the same grades among individuals. Any circles of life will show the same relative conditions in men who have never been in college What A and B and C and D, or 60 and 70 and 80 and 90 mean in a college life is nothing different from what $1000 a year or $2000 a year or $5000 a year or $10,000 a year mean in a life outside of college

Yet, there is a need to answer directly the questions at the head of this paper, which are taken from the reported interview with Mr Edison in the November SCIENTIFIC AMERICAN There *are* certain faults in the process of college training which, if corrected, would enable the colleges to do even better work than they are doing now When the question, "What Are the Colleges Going to Do About It?" is aimed at these faults, every college officer is thoughtful, for he knows that criticisms based upon actual fact must be met seriously The process of training which the college affords is now handicapped by two things large numbers of students, and small numbers of experienced teachers. The first means large classes of instruction, so large that individual contact of mind with mind is almost impossible, the other means that when these large classes are divided into small instructional sections, there are not enough experienced teachers to go round

The large class is a menace to the output of a very fine product That is universally true where anything other than a mechanical process is involved A good cook may make a delicious pie. Delicacy may still be present if he makes two pies. At some point delicacy is inversely proportional to the number made at one time Mark Hopkins and one student is still the ideal college Mark Hopkins and ten students might produce good results, but Mark Hopkins and fifty students would result in poorer product There is a limit to the extent to which a man's personality and mentality can reach under a single set of conditions. We may hope for a day when there will be no classes in our colleges larger than ten or a dozen students.

If the colleges are fortunate enough to be able to divide large classes into small sections, the quality of the work done will be improved in all those sections when each is in charge of experienced and successful teachers. The freshman year and the senior year are relatively more important than the sophomore and junior year, and of these two, the freshman year is more important than the senior In that period the boy must get accustomed to the larger freedom that comes when the restrictions of home are released. He begins to be controlled from within rather than from without He learns to assume the responsibility of making his own choices. It is the period when the boy needs the strongest, the most intelligent and the finest pedagogy The full professor of the colleges who asks to be given advanced students only and to be released from the monotony of teaching freshmen does not appreciate the fine opportunity that is his. I cannot say what the colleges are going to do about it, but I can say that when the college can have small instructional sections, and when it will bring its freshmen into immediate contact with its best, strongest and finest men, there will be an improvement in its products. The good men who are products of the present process will be better men, and there will be more of them.

The Age of the Earth

AT the meeting of the British Association in Edinburgh in September last a joint discussion on the age of the earth took place under the auspices of the sections for Mathematics, Geology, Zoology and Botany The inadequacy of Lord Kelvin's original estimate of twenty or thirty million years has long been admitted. The more recent estimates are for a much greater age.

Lord Rayleigh considered that the most accurate estimate of the age of the earth can be derived from the rate of radio-active disintegration. Uranium passes through a series of successive stages during its disintegration which terminate in an isotope of lead, having an atomic weight less than that of "ordinary" lead, but chemically indistinguishable from it. The order and rate of this disintegration through successive stages are known with a high degree of accuracy, so that a determination of the amount of the isotope of lead present in minerals containing uranium enables the time when disintegration commenced to be assigned without very great uncertainty In this way an age of about 1,000 million years is derived from pre-Cambrian rocks.

Professor Gregory dealt with the geological estimate of the age of the earth, based upon the salinity of the sea Estimates obtained in this way varied from 70 to 150 million years. He pointed out that the argument suffered from three fundamental objections. It was assumed that the sea was originally fresh, although the oldest fauna, the Cambrian, had marine characteristics, and the contrast between the fresh water and marine fauna in Palaeozoic times was as sharp as it is today There was also no allowance for the large supplies of sodium chloride raised from beneath the earth's surface by magmatic waters. Further, a uniform rate of denudation was postulated, whereas there have been alternating periods of quick and slow crustal movements the earth is now under the influence of a time of quick movement, with consequently, denudation faster than the average Taking these three causes separately, Professor Gregory estimated that, to allow for them, the age of the earth deduced from the salinity argument should be multiplied two-fold, three or four-fold and five-fold respectively He concluded by stating that the best known geological estimates of the age of the earth requires to be multiplied ten or twenty fold in order to agree with the physical estimates, and that this increase is consistent with the geological evidence.

Dr Jeffreys stated that, from considerations of the temperature distribution downwards in the earth's crust, allowing for the radio-active content, and also from the tidal theory of the origin of the solar system, he had separately devised concordant estimates of about 2,000 million years since the solidification of the earth's crust. Thus with revised data, two of Lord Kelvin's methods of reasoning have been brought into agreement with the results derived from other physical methods. Lord Kelvin's third method—the contraction hypothesis—is not valid on account of the existence of other sources of stellar energy.

It will have been gathered that, on the whole, there is now a satisfactory agreement between the results of arguments based upon astronomical, physical and geological considerations. These indicate an age of the earth, since solidification, of 1,000 million years.

Inventions New and Interesting

A Department Devoted to Pioneer Work in the Various Arts and to Patent News

A brush for every customer, thrown away after use, is made possible by this arrangement

The Sanitary Shaving Brush

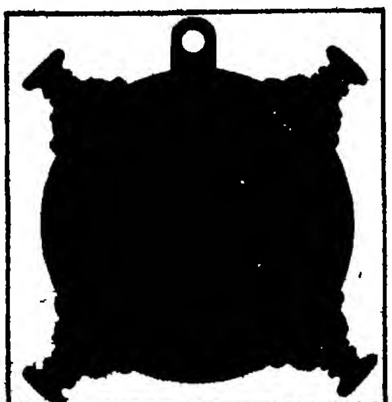
SANITARY requirements enforced upon barber shops and similar establishments these days are pretty severe, and it is not always a simple matter to know just how to proceed with the business of shaving, manicuring, massaging, etc., in accordance with the demands of the public health authorities. One of the problems revolves about the shaving brush. We all know the extent to which the deadly anthrax germ lurks in this, and anthrax is only one of its possibilities. Sterilization of the brush after each usage is easy to say, but it is less easy to do, less easy still to keep an eye on the individual barbers and see that they do it—and it costs money. Nor is it of much avail to sterilize brushes in a puddle of dirty water, such as is sometimes seen in use for washing glasses at a carelessly conducted soda fountain.

The inventor has come to the rescue of the barber in this predicament, and has provided a brush that is used only once, and then thrown away. A little tuft of sisal fiber constitutes the business end of the brush, and it is clipped into the handle and used. Then it is released and a fresh tuft substituted, and instead of being more or less cleaned for reuse, the used brush-end is thrown out. The principle of the safety razor, in other words, is applied to the brush. One handle, many blades, has been a familiar situation for some years, and now we shall have one handle for many brushes.

Simplicity in Hose Clamps

RADIATOR hose clamps are one of the banes of automobiling. Most of us have struggled with screw-driver and pliers, trying to hold the one end while we turned the other, to loosen a recalcitrant clamp, and most of us have been stranded with an old clamp that has just been removed, that is hardly fit for service again, and for which we have no substitute. A clamp that works without a screw sounds good, at first thought, until the awful thought comes that if it has no screw it certainly must have a spring. But we illustrate a clamp that has neither screw nor spring—unless one insists upon the technicality that the clamp itself is a spring. It works by means of little "adjustment slots," the edges of which are raised sufficiently to catch and hold the pawl, against the spring-action of the clamp itself, when one pawl is pressed into engagement. It has five of these slots, giving a range of three eight inch sizes. The lever that works the pawl is operated with one finger, and the clamp can be attached in a fraction of the time ordinarily required.

The hose clamp that works without screw or spring



The shell of the hammer-blow timer, with one part broken away to show the mechanism

The Hammer-Blow Timer

EVERYBODY who has ever driven the universal popular-priced car for any distance knows that its weak spot is the timer. Every garage mechanic has his favorite replacement timer, which he advocates and puts on if permitted, and which usually does give better service than the one that came with the car. Of these replacement timers, some give their better service through the use of better materials. These are nice enough to have on your flivver, but they do not make an interesting story. Occasionally we find one that bases its claim to superiority on a different mode of operation, and then we have a story to tell. One of this kind is illustrated herewith.

The trouble with the standard timer for the flivver is that the brush and the contact posts make a wiping contact while the brush is in rapid rotation. After a few million turns it is self-evident that the contact surfaces are going to get worn, that contact will be less clean, and that the spark will accordingly be less efficient—if, indeed, it is not now and again jumped entirely. The timer we illustrate differs from the usual type in that there is no current at the point of wiping contact. The roller acts not as an electrical member at all, but simply as a cam. It strikes one post after the other as it rotates, and drives each down, against the pressure of a spring, to make a hammer-blow contact at the gap shown in the illustration. It is clear enough that the roller itself, and the post against which it delivers its pressure, may become so seriously worn that they would utterly fail to function electrically, and yet the shock of contact would remain sufficient to drive the floating hammer home and make the necessary electrical connection at the gap.

A Screw-Driver for an Emergency

ONE of New York's prominent citizens was recently locked, with his wife and eight servants, in his air tight wine cellar, which has a combination lock. In the pitch darkness he managed to break off the blade of his pocket knife and, using the stub as a screw-driver, to remove the combination plate of the lock from the inside of the vault door, releasing the party just about in time to avoid serious respiration difficulty. The tale is told merely to demonstrate that one never knows when one may need a screw-driver. A thin-edged washer, carried in the vest pocket, is the latest idea for an emergency screw-driver, and will usually do the work unless the screw is too firmly set.

A pocket screw-driver for use in a hurry

Some details of the arrangement by which the live axle may be removed through the hub

A Double-Duty Table-Tool

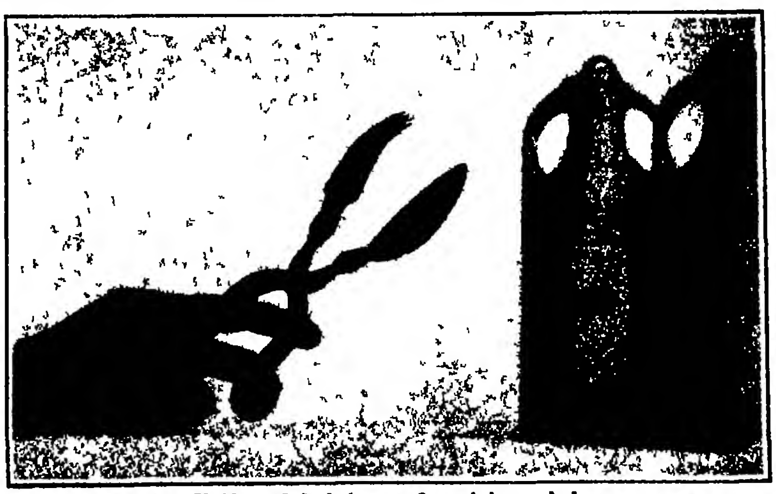
A DOUBLE advantage is to be gained by using this device, invented for the purpose of mixing salads. In the first place, the housewife always has the necessary fork and spoon united so that the spoon can be used for measuring, the fork for stirring, and the combination for lifting the lettuce up and down in the bowl. Another advantage is that they are made of horn, doing away with rust and corrosion of metal from the vinegar and salt used in the salads.

An Innovation in Axles

A LIVE axle that can be removed through the hub-hole of the wheel, without removing the wheel or even jacking up the car, is claimed in U. S. patent No. 1,274,550, issued to Mr. J. B. Ketchum of Hampshire, Ill. Mr. Ketchum supplies us with a photograph of an axle constructed according to this idea, showing the essential features by means of which it may be removed by simply removing the hub cap. The latter is bolted to the wheel hub by the same six bolts that hold the spokes in place. This hub can be fitted with any style bearings.

Weight of Steel Rails and Their Life

THAT the weight of a steel rail is an important factor in the life of the rail but in an entirely different way than might be expected has been established by the experience of one large Eastern railroad. In the last few years the road referred to has gradually replaced



Knife and fork in one for mixing salads

A muffler for the radiator—combined with a humidifier

its 80-lb rails with 105-lb rails. A careful record of the life of the heavier rails compared with that of the lighter ones has brought out the rather astonishing fact that the 105-lb. rail lasted in the regular road bed 2.7 times longer than the 85-lb rail did with very little change in chemical composition. In other words, the addition of 25 pounds to the yard has increased the life of the rail 270 per cent

But the ratio of increased life is not the same above or below these figures. It has been found that the 130-lb rail lasts only 40 per cent longer than a 100-lb. rail while a rail of the 80-lb class lasts only about twice as long as the 60-lb. rail

In 1910, the country's rail production was 12.18 per cent of the total finished steel output, in 1913 it was 14.12 per cent But in 1919 and 1920 rail production was 8.77 per cent and 8.05 per cent respectively of that of finished steel This wide difference, it is claimed is not due altogether to railroad control nor to lack of funds or similar causes. It is the conclusion of the railroad referred to that the extensive adoption by the leading large railroads of the country of the 105 lb. rail, with its much longer life, has been a strong determining factor

Beating Eggs by Faucet Power

IN the top of this mason jar cover is a small water motor When the water is turned on very slightly the beating device within the jar starts action. Motor and top of jar are made in unit, to fit any standard glass jar An adapter is provided for the faucet that does not have threads. Egg-beating device screws on much as does the garden hose

Simple water-motor for beating eggs

Noiseless Steam Radiators

THIS device combines a steam radiator valve silencer and a humidifier The long tube is screwed over the valve in place of the regular cap, and when properly adjusted takes the noise away The pan of water needs replenishing every three days. Any leaking runs into the pan and prevents water from running on the floors.

Cutting Fluids

MACHINISTS have long recognized lard oil as well nigh indispensable in certain cutting operations, though for the majority of machine-shop work much cheaper oils may be used to advantage The reasons for the superiority of lard oil have not been clearly understood, but they turn out to be closely related to the general theory of lubrication, and with the development of fast-moving machines this theory is of vast economic importance

The purposes of cutting fluids are to cool the work lubricate, lessen wear, insure a good finish with accurate dimensions, wash away chips and prevent the formation of dust The materials used may be classified as oils, air, water and aqueous solutions, and emulsions. For mere cooling water, with its high specific heat, is ideal. But it tends to rust the machines so, while used to some extent, it usually has added to it soda, sodium silicate, sodium resinate, or other alkaline substances. Moreover, in difficult cutting operations the chip is apt to "seize" the tool causing dullness of the tool roughness of the work, etc Hence it is inferred that in such cases water is out of place and some actual lubricant is required

Oils may be of animal fish vegetable, or mineral origin or compounded of two or more of these The edible animal oils are too expensive for use as lubricants, hence only the inferior grades are thus utilized Fish oils are objectionable unless deodorized vegetable oils tend to gum and mineral oils are low in adhesion and therefore poor lubricants. Compound oils are largely used, containing a large percentage of mineral oil with a smaller percentage of vegetable or animal oil, or of both Air is used merely to remove chips.

The experiments of Tower led many to the erroneous belief that two oils of the same viscosity would have the same lubricating value Consequently the cheaper mineral oils have in many cases been looked upon as equivalent in every respect to the fatty oils. There are, however, certain operations in the machine shop, such as the threading of micrometer screws, threading and tapping wrought iron, parting off mild steel, boring gun barrels, etc., in which no mineral oil, regardless of its viscosity, will produce the excellent results obtained with lard and other fixed oils. With lard oil the surface obtained is smoother, the chip less serrated and longer, the tool of longer life, the production increased, heating minimized, and the machine found to run more steadily

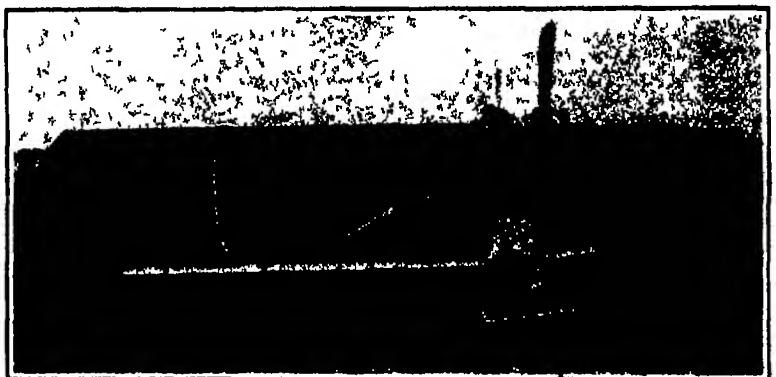
It appears that whenever two clean surfaces of metal are brought together they tend to seize. Many examples prove that a quite invisible layer of impurity will prevent seizure The clean metal of the chip moving over the face of the tool under great pressure affords a peculiarly difficult problem in lubrication Lard oil has a much higher *adhesion* for metal than do the pure mineral oils. It is drawn in between the chip and the tool and forms a strong film which prevents the chip from adhering to the tool and forming a "bead." Other oils containing fatty acids, or groups of atoms with "residual affinities," such as sperm oil, castor oil, rape oil, etc, have in large measure the advantage of lard oil.

The whole subject is discussed at length in Technologic Paper No. 204 of the Bureau of Standards, prepared by Eugene C Bingham. It seems readily possible to improve mineral oils as cutting fluids and as lubricants by adding liquids of high adhesion such as oleic acid, pine oils and fixed oils. Methods are suggested for the measurement of adhesion. The Deeley friction testing machine and the Lanchester worm gear machine, developed in Great Britain recently, demonstrate the superiority of the fixed oils as lubricants, and the advantage of adding them, or their acids, to mineral oils intended for lubrication

Emulsions have the advantage of cheapness while possessing much better lubricating properties than the aqueous solutions. Mineral oil compounded with neutralized sulfonated oil will form a permanent emulsion when mixed with various proportions of water. Mineral oils are compounded with an alcoholic solution of soap. A third variant is marketed as a paste, it being a thick soap solution, plus mineral oil The second type is the most desirable and the third is the least so.

As to the choice of a cutting fluid for a given operation, the character of the operation performed has more to do with the choice of cutting fluid than the character of the metal. For drilling, reaming, milling, planing and sawing emulsions are generally satisfactory For tapping and threading and parting off, compound oils and lard oil are often resorted to. Compound oils are used with automatic screw-cutting machines.

The material cut is, however, not without some bearing upon the problem. There is a general consensus of opinion that soft steel and wrought iron are difficult metals on which to get a good surface without lard or sperm oils. They are called "draggy" metals. Cast iron, on the other hand, being brittle, does not adhere to the tool and no lubricant is required. Contrariwise, on a hard, brittle steel, lard oil merely produces a "glaze," and turpentine is used with success.



All-metal plane of French design, with detachable wings

The wire grid cuts the slab of butter into 48 pieces at one operation

A Rapid Butter-Server

A POUND of butter placed in this apparatus may be cut into forty-eight segments at one stroke Press down on the brick of butter with one hand and operate the metal handle with the other, Crosswise wires divide the mass into its many parts, while the cutter underneath determines the thickness.

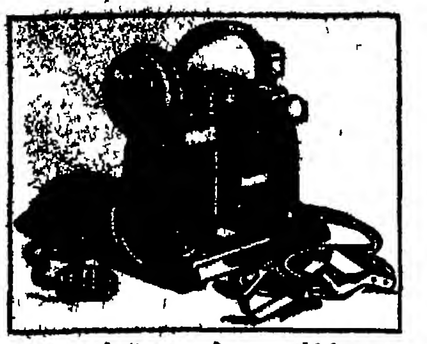
The Vest-Pocket Airplane

DEVELOPMENT of the all-metal plane is taking a curious direction in France, and we may shortly expect to have announcements of the plane that can be carried under the arm. We illustrate a step toward this goal—a metal plane with detachable wings, which it is claimed can be taken off or put on again in two minutes. The tested speed of the machine is 120 kilometers—about 70 miles—per hour

Something Different from the Jack

WE illustrate a simple little contrivance, invented by Mr. Lynn Beadle of Detroit, which is intended to do away with the automobile jack. It is a light but strong bridge of cast steel, which is screwed into two holes bored for the purpose in the felloe of the wheel. The car is then driven ahead or back a few feet until the no-jack bridge comes down and the wheel rises on it. A tire may then be removed and replaced, chains put on, etc With this device the wheel can be lifted into place for easy tire-changing in seven seconds. The attachment also serves as a spare-tire guard, and as a mud hook or sand-hook for driving over heavy roads. The difficulty of burrowing into a mess of mud that rises high about the tire to find a place of support for the jack is altogether a thing of the past with this handy little apparatus which solves this problem automatically

The substitute for the jack that uses the car's own power [illegible]



Storage battery recharger which may be used with the usual alternating current lighting circuit

A Storage-Battery Recharger for the Home or Garage

EVERY so often it becomes necessary to recharge the automobile storage battery by some external means. This is particularly true when the automobile has been standing idle for a long period and the battery is discharged to a point where it will not start up the engine. Again, since the widespread introduction of radio receiving sets, especially of the vacuum tube type, which requires a storage battery, a recharger is virtually indispensable unless one is willing to send the storage battery to a recharging station every ten days or two weeks, with the trouble and great expense which such procedure involves.

The present storage battery recharger, shown in the accompanying drawing, is of the vibrating type for use on alternating current circuits. Its vibrating member, supported between the pole pieces of powerful electro-magnets, rectifies each half of the alternating current cycle so that direct current is obtained, after the transformer member of the recharger has already stepped down the alternating current voltage to the low potential required for recharging purposes. The ammeter indicates the output of rectified current which is available for the storage battery connected to the recharger by means of the flexible leads and the clips.

The recharger in question can be used anywhere. Indeed, it is provided with a handle so that it can readily be carried about from place to place, and connected with any alternating current source by means of the attachment plug and cord.

For radio purposes the little recharger is ideal. The author of these lines has employed one of these rechargers with satisfactory results. The 6-volt 6-ampere-hour storage battery delivers current for approximately 20 operating hours to a vacuum tube detector and two-stage amplifier, after which it must be recharged. The recharging station fee is generally $1.00. By means of the little recharger, however, the same battery can be recharged in about 18 to 20 hours at a cost of 12 to 15 cents, according to the writer's experience. This cost is based on current at 15 cents per kilowatt hour The recharging rate for such a battery with this recharger is 5 to 6 amperes.

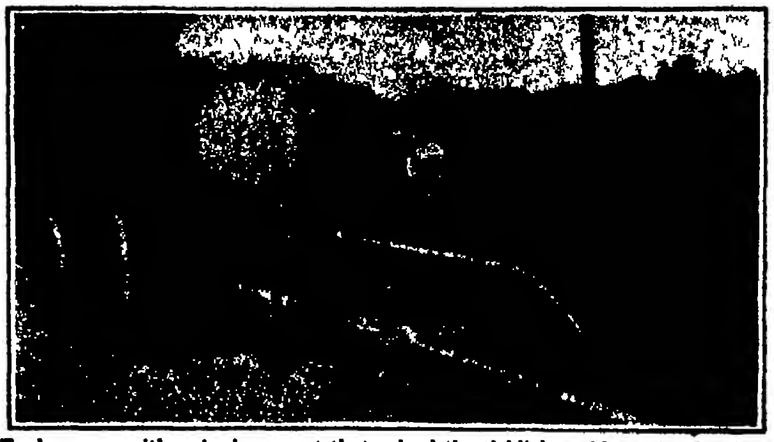
Motive Power from Sewerage Gas by a Unique Method

AMONG the many suggestions for developing motive power, probably none is more unusual nor unique than that of using sewerage gas. A British engineer, however, now seriously advocates this.

After recalling that the project was by no means new, having been used more than 25 years ago, with a septic tank for lighting sewerage works, the lecturer proceeded to relate some of his own experiences and investigations. He had visited the Matunga Leper Asylum at Bombay early in 1920, and had seen there a small engine which had been driven on this medium as far back as 1907 This in itself indicated the practicability of the scheme, but more recent work carried out at Parramatta, Australia, under "aerobic" conditions had finally decided him to try the potentialities of sewerage gas in a colder and more changeable climate

An opportunity had been found at Cole Hall Sewerage Farm, Birmingham, where a suction-gas plant had been adapted at slight expense The plant consisted of a 34 h.p. horizontal engine, a 5-in centrifugal sludge pump, a small well, a sludge-digestion tank, and a gasholder Previously the obtainable sludge had been very watery, and contained no more than 3 per cent of solid matter but a denser material, containing about 10 per cent, would shortly be conveyed by a new main. Even with the more volatile liquid, however, considerable success had been achieved in deriving sufficient power to work the pump. At Cole Hall most of the sludge was bought by farmers for manure, and only the amount necessary for the power plant would be subjected to fermentation

There remained the question of economy to be considered, and evidence on this subject pointed to the value of sewerage-gas operation over a suction-gas plant It had already been determined that a gas-production of 25,000 cubic feet from four tons of solid matter was obtainable at the Cole Hall Farm, and this amounted to a gasification of 18 per cent.

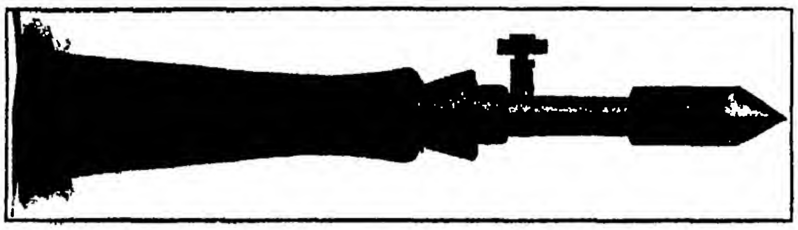


Tank wagon with swinging spout that solved the ticklish problem of irrigating the young shade-trees along a California highway

Irrigating the Row of Trees Along a Road

CITIZENS of Glendale, California, recently undertook the beautifying of a five-mile stretch of motor highway between that city and Eagle Rock A part of this plan called for the cultivation of rows of live oak trees along the sides of the highway In a region where rain fall is abundant all the year, producing such an avenue of trees would be very simple, but in southern California we have a long arid season, when young trees will die if not carefully watered After the live oaks have attained sufficient growth to acquire deep rooting they will take care of themselves and thrive through the dry summer

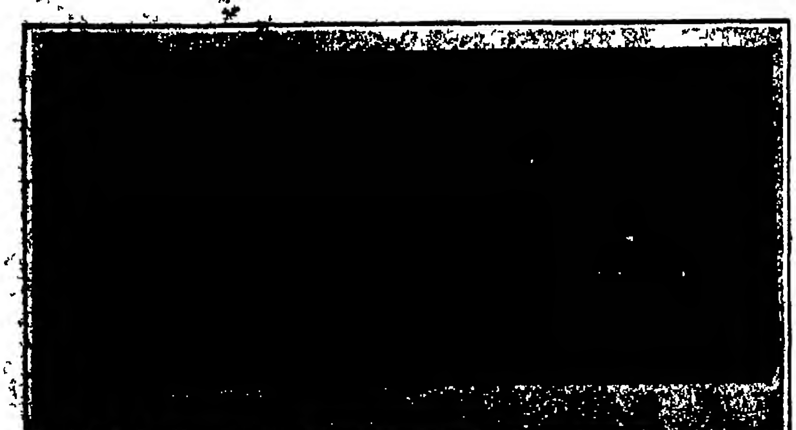
Irrigating the five-mile lines of young trees on either side of the highway presented a problem seldom encountered in irrigation, but not to be defeated in its purpose, the city caused to be built a rather novel tank wagon with a swinging water spout With this wagon, shown in the accompanying photograph, the gardener drives along the avenue After filling the tank wagon he drives from tree to tree, watering each one, and carefully cultivating the soil about the tiny trunks. This method of watering the trees has not only been found thoroughly successful, but the work is accomplished with a minimum of labor



This soldering iron contains an alcohol blow torch in the handle

An Improved Inside Micrometer

THE inside micrometer calipers is a tool to which attention has not been given in proportion to its intrinsic importance We illustrate a newly marketed and greatly improved outfit which is intended to remedy this lack In the construction of barrel, spindle and thimble the regulation diameter of these parts as found in the usual outside micrometer is used, affording a much sturdier tool and one more suited for use in garages and repair shops, and permitting larger figures on the scale. The handle is detachable, and in such a way that the tool can be instantly changed from right-hand to left-hand use, so as always to present the scale for easiest reading Interchangeability of the various rods is promoted, it is necessary only to unscrew the rod from the threaded stud at the end of the barrel. These rods are interchanged by simply unscrewing from the threaded stud at the end of the barrel Each is internally threaded and ground square at the hardened end, which sets squarely against the barrel shoulder, while the rod at point of measurement is fitted with a hardened tool steel anvil which can be adjusted to lengthen the rod and compensate for any anvil wear resulting from constant use The anvil faces are ground on a comparatively small radius, making the micrometer especially adaptable for measuring parallel or curved surfaces.



An inside micrometer set that is unusually easy to use

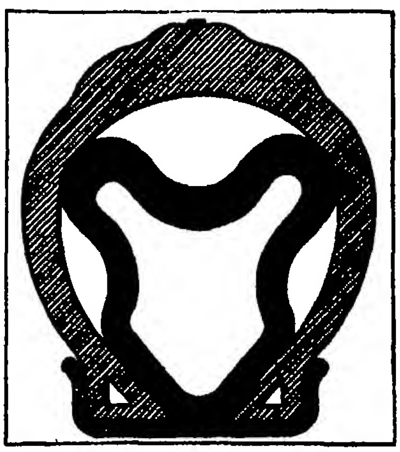
A Soldering Iron That Contains Its Own Blow Torch

BY having a blow torch form part of a soldering iron there has recently been developed a soldering iron that may be used anywhere with all the convenience that has heretofore been such a powerful argument in favor of the electric soldering iron

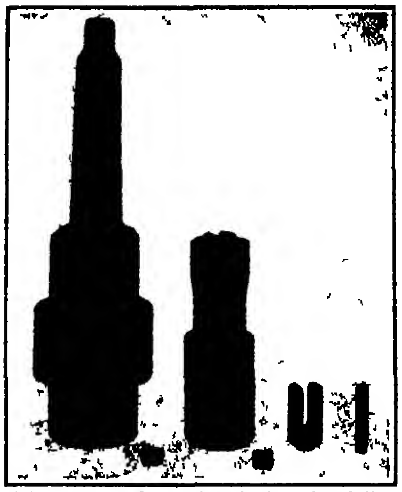
The new soldering iron which is shown in the accompanying illustration, contains an alcohol blow torch. The reservoir of the blow torch is inclosed by the handle a brass filling cup, which is reached by removing the end cap of the handle, gives access to the reservoir for refilling The blow torch is started by pouring alcohol or gasoline into the cup member about the base of the soldering iron stem When this primary charge is ignited it heats and vaporizes the alcohol, and gives a hot blow torch flame which is directed against the base of the soldering copper A needle valve controls the flame The soldering copper may be removed so that the blow torch may be used alone

The Tube That Repairs Its Own Punctures

WE illustrate about as ingenious an attack as we have yet seen upon the eternal problem of the puncture-



Cross section of the compression inner tube, showing it uninflated. When filled with air, the wall is under severe compression and tends to close a puncture at once



The safety chuck for drills—the drill cannot break when overloaded because the soft pin shears off first

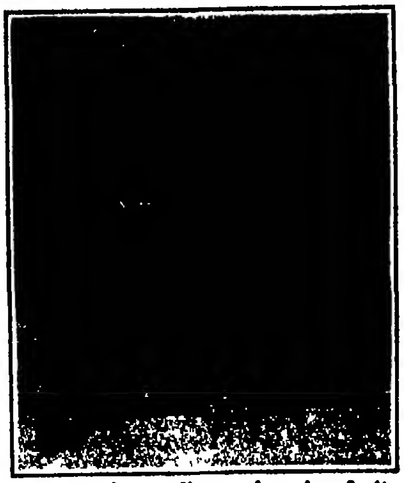
proof tube. The inventor tells us that rubber will flow, if we give it half a chance, and fill a puncture. He accordingly makes his tube with a circumference considerably greater than the inner surface of the casing for which it is designed. The extra rubber is taken care of, and it is made possible to insert the uninflated tube inside the shoe, by deep corrugations that are molded around the tube, as indicated in our diagram, which shows the uninflated tube in position in the casing. When it is now inflated, and forced by its contained air to conform to the shape of the casing, a pressure is set up along its outer wall which is claimed to be sufficient to close the hole made by any ordinary puncture, and keep it closed. The "compression tube" is made in Tulsa, Okla., and has been in rather extensive use in the southwest, with very good results.

Removes Skins and Seeds Quickly

A SCIENTIFIC fruit and vegetable press has been designed which shortens work, saves food and improves the flavor. Apple sauce is made with the *skins on*, then removed with this rotary press. It improves the flavor, so authorities tell us. The wooden roller can be given a good scrubbing after use. By the removal of all skins on vegetables, stomach doctors tell us, much irritation to this organ is reduced.

High-Speed Drilling Without Breakage

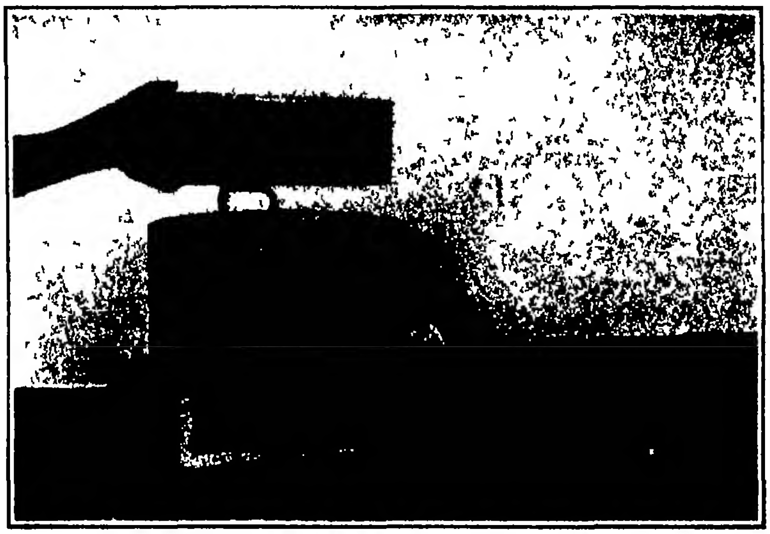
QUICK-CHANGE drill chucks for drills with taper shanks are nothing new, but the makers of the one illustrated herewith believe they have in it something that is new. This chuck has a safety device which prevents drills, taps, reamers, counterbores, etc., from breaking and burning. The device in question consists of a soft steel pin which drives the collet without a hitch ordinarily, but which shears off when the cutting tool is overloaded. The sheared pin is then removed by simply loosening a screw, and a new pin inserted in its place. Soft pins are altogether cheaper than hard, shaped and edged or pointed cutting tools. And aside from this direct economy, it is claimed that steel can be drilled at a rate of 5 to 7 inches per minute when the operator knows that he cannot harm the tool, and cast iron at 10 to 14 inches per minute. In drilling at this rate two strong chips develop and force themselves out of the hole, carrying with them much of the heat generated.



A press for seeding and paring fruit and vegetables

A German "Stunt" for Saving Gas

ONE of our German correspondents shows us a rather clever use of an ordinary heating coil in conjunction with a gas stove. Two holes, one above the other, are pierced in the outer member of a double boiler or similar vessel, the two ends of the coil are inserted, and the coil itself arranged so that when it is set over the gas burner it takes an advantageous position with reference to the flame. The coil is filled with water at the outset and as much water put in the double-boiler base as is considered desirable. the natural circulation of the water which takes place with heating, and which makes the ordinary kitchen boiler and the thermo siphon system of automobile cooling effective, at once gets in its work, and that is all there is to it. The single gas flame can in this manner be made to serve three purposes—it will cook something set immediately over it, cook the contents of the vessel to which the coil leads, and heat the water in this vessel and in the coil for any use which it may be possible to make of it after the cooking is done.



An efficient heating coil for use with a gas-stove

Transmission of Electricity from Norway to Denmark

THE question of transmitting electricity from the Norwegian waterfalls to Denmark is now well under way, a committee of official representatives for Denmark, Norway and Sweden being at present engaged in establishing a definite scheme. In fact, inasmuch as the possibility of carrying electric power from Norway across Western Sweden as far as Gothenburg, and thence by submarine cable to Denmark, had for some time been under discussion, Sweden obviously is likewise interested in the scheme. However, the Danish representative, Prof. Wm. Rung, has just worked out a new plan by which electricity is to be transmitted by a submarine cable from Norway immediately to Jutland. Any difficulties at first encountered in this connection have been overcome by using direct in the place of alternating current. The cost of the scheme is estimated at 40 million kroner, covering the cable to be laid through the Skagerrak, the erection of two large receiver stations at Vendyssel and Kolding respectively, and the installation of high tension lines destined to carry electricity to Jutland, as far southward as the German frontier. Zealand and Funen, on the other hand, will by means of the cable already installed in the Sund be supplied with Swedish electricity, which even at present is transmitted to northern Zealand.

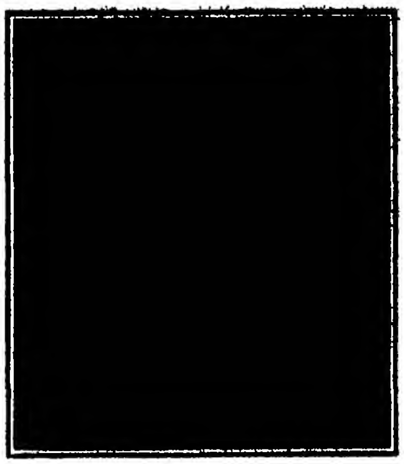
An Electro-Magnetically Operated Violin

ENDEAVORS have long been made to set up permanent vibrations in the strings of musical instruments by electromagnetical means. While an electromagnet arranged close to a string will attract this on receiving a current impulse, in order again to release it as the current ceases, this process only results in harping of the string, thus being a mere equivalent of striking or pulling it with the finger.

According to German press notices, Dr. Otto Schaefer, of Hamburg, has, for the first time, succeeded in designing an attachment which receives a number of current impulses corresponding to a number of vibrations of the string. The sound produced by pressing down a key is said to have a surprising effect, being soft and full, free from any secondary noises and comparable with the softest string registers of an organ. Some difficulties experienced in carrying out his idea, Dr. Schaefer only overcame after many years' assiduous work.

A point of especial importance and which shows the great superiority of the new instrument as compared with organs, is the fact that in addition to a pedal, alternating the intensity of all the sounds struck at a time, the strength with which each key is depressed will control the strength of the corresponding sound. In fact, the sound is said to obey the slightest pressure of the finger even to the point of allowing a *vibrato* to be produced. The melody can, accordingly, not only be set off from the accompanying voices, but can be brought out with the whole charm of swelling and waning sounds.

The inventor has so far been able to demonstrate the principle of his invention only on individual sounds and harmonies, but looks forward to the construction of an entire instrument.



A quick-and-easy broiler for the modern kitchenette

A New Way to Cook

MEATS are placed on this vertical grid and shut up inside the broiler, placed over a fire and in a very short time steak, chicken, fish, etc., can be broiled on *both sides* without turning. A pan in the bottom catches the juice.

Shingles of Copper

SHINGLES of copper is one of the products being specialized in since the war. A large American company has put on the market copper shingles in three sizes: 6 by 18 inches, 8 by 18 inches and 8 by 60 inches, all weighing approximately 84 pounds to the square of 100 feet. The roof of a large church in Brooklyn, N. Y., is to be covered with such shingles which are regarded as probably the lightest substantial roofing material.

The weight of copper shingles compares with 200 pounds to a square of 100 feet for the wooden shingles, 400 to 600 pounds for asbestos, 750 to 1200 pounds for slate and 1000 to 2000 pounds for tile.

Rotary Pump of Extreme Simplicity

A ROTARY pump with but three moving parts, no valves and no packing, is the claim made for the apparatus of which a sectional view is given herewith. It comes to our attention as the result of a recent test at Houston, Texas, during which a three-inch model lifted water 29¼ feet and pumped at 100 pounds pressure, in both cases being driven by a motor of only one-half horsepower. In addition to its availability as a pump, the device also run as a steam turbine at 6000 revolutions per minute. The pump, which is the invention of L. F. Smith of Houston, is claimed to be suitable for pumping anything from water to the thickest of Mexican crudes.

Valveless rotary pump with three moving parts

The Service of the Chemist

A Department Devoted to Progress and Achievement in the Field of Applied Chemistry

Conducted by ISMAR GINSBERG Chemical Engineer

Pigments in Australia

AN investigation of the geological formations in Queensland has shown that large deposits of valuable oxides and ochers exist near Sooktown, especially in the vicinity of Cape Flattery. A sample of Indian red, obtained from that region was analyzed and found to contain almost 50 per cent more iron oxide than the ordinary pigment, one-third as much alumina and no carbonate of lime. It is stated in the official report that if the latter constituent is required, it can easily be supplied from neighboring coral reefs.

Wax from Sugar Cane

ACCORDING to the *Oil, Paint and Drug Reporter*, January 16, 1922, a wax is obtained from sugar cane, which resembles carnauba wax very much. The cane itself contains about 1 per cent of this wax, which is found principally in the rind. In the sugar refining process this wax is removed in the filter cakes, and the latter have been known to contain as much as 10 per cent of this substance. It is possible to extract the wax by means of benzine, and there are certain isolated plants which are today carrying out this process. The crude wax is hard and brown, and looks much like beeswax, but when it is purified, a product is secured which not only resembles carnauba wax closely, but which can be used to good advantage as a substitute therefor.

Gasification of Coal Dust

WHAT to do with coal dust has been a difficult question which has received much attention from chemists and technologists. Burning it in the furnace, briquetting it in admixture with tarry products have been suggested and processes and apparatus have been devised and are now in use for carrying out these suggestions. Recently, the gas manufacturers in Germany have been experimenting with coal dust in the manufacture of gas. In *Chemiker Zeitung*, 1921, pages 780 to 790, there appeared an article on this subject, in which details of the operating method and of the apparatus used are given. Briefly, the process consists in atomizing the coal dust with superheated steam and then passing the mixture over highly heated bodies. In this way the coal dust is subjected to a distillation process, and there are recovered the various products usually obtained in the destructive distillation of coal. Coke dust is formed as well and this reacts with the superheated steam to form water gas. The process is continuous and possesses the advantage of total consumption of all the ingredients of the coal, as the coke that might be recovered in such a process would possess but little or no value, due to its granular condition.

New Fertilizer and Insecticide

ACCORDING to the French publication, *La Revue des Produits Chimiques* (reprint in the *American Gas Journal*, January 14, 1922), the spent purifying mixture, recovered from gas works and originally containing slacked lime and ferrous sulfate, can be used to good advantage as a fertilizer and insecticide. The purpose of this purifying mass is to remove ammoniacal and cyanogen compounds from illuminating gas, and when the potency of this material for this purpose is exhausted, the mass contains about 7 per cent nitrogen.

As there is contained in this spent material a certain amount of sulfocyanides and ferrocyanides it may be used advantageously as an insecticide and weed killer. In this fresh condition it must not be used after the plants have commenced to grow, as it will destroy all vegetation, but if it is strewn over the ground before the plants come up, it will positively kill all growths of weeds and injurious insects, and by the time that the plants have come up out of the ground its poisonous character will have disappeared and its properties changed into that of a fertilizer. In order to be able to use it first hand as a fertilizer it is necessary to age it. The aging process serves to convert the sulfocyanides and ferrocyanides into ammoniacal products. Careful tests made with the material have corroborated the claims made for it.

Rubber Latex in Paper Making

THE rubber latex, in the condition in which it is tapped from the tree, that is, in the non-coagulated form, is used in admixture with paper pulp in the beater to form a rubber paper, which is said to possess remarkable properties. While the process may not be practical, it is very interesting and has been patented in England and is a reflection of the strenuous efforts that are being made at the present time to find new outlets for the superabundance of rubber in the world. The process consists in adding the latex to the extent of 0.5 to 5 per cent of the paper stock to the pulp beater. After a thorough mixture has been obtained, a coagulating agent is added, such as acetic acid or mineral salts, which converts the latex mixed with the paper fiber into a gel. The paper-making process is then carried out in the ordinary manner, and the dried paper can be vulcanized by the cold vulcanization process. The product is a paper of high strength and considerable resistance to shearing. It is claimed that a very good grade of paper can be made in this manner from very poor quality pulp. For further details the reader is referred to British Patent No 167,935.

Ammonia from Sugar Refinery Refuse

ACCORDING to the French magazine, *L'Engrais*, November 15, 1921, a sugar refinery in France has undertaken to manufacture ammonia from the nitrogen found in molasses and vinasse, which are recovered in the process of refining sugar. It is estimated that if all the molasses produced in France were treated by this process about 17,000 tons of ammonium sulfate would be produced yearly.

Viscose Silk with Artificial Resins

ARTIFICIAL silk is made from viscose, or rather one type of artificial silk is known as viscose silk. In dyeing this sort of material, it has always been difficult to obtain fine dark shades. Another difficulty has been the tendency of the silk to be affected by water. According to a recent discovery made by E. Bronner of Mulhouse, France (see British Patent No 171,125), the artificial resin that is obtained in treating phenol with formaldehyde is added to the viscose before spinning and preferably before ripening. The addition of the artificial resin has the effect of making the silk threads take darker shades in the dye bath. It also enables them to resist more effectively the action of water.

Borax in Photography

THE action of borax in photography is very paradoxical, as in certain cases when added to the developer it serves to accelerate its action and in other cases it has a retarding effect. This is explained by the fact that while borax will give a decided alkaline reaction when dissolved in water alone, still when added to a caustic soda solution it will decrease the alkalinity of the same. Hence, when it is added to such a developer as hydroquinone containing caustic soda, the alkalinity is reduced and the developing action of the reagent is retarded. Other substances such as bicarbonate of soda and sodium phosphate will do the same thing. Borax has been recommended as an addition to developers in order to produce a diminished grain in the picture. (See December 31st number of *Chemical Trade Journal*.)

Fertilizer from Blast-Furnace Gas

PLANTS need carbon dioxide to grow. The air contains this gas to the extent of about 0.03 per cent. When this proportion is increased as in the air in green houses, the plants were found to grow much more rapidly but the cost of producing the additional carbon dioxide gas is out of proportion with the results obtained. According to *Canadian Chemistry and Metallurgy*, January 1922, experiments have been made in Germany in using the waste gas of blast furnaces for this purpose. The success obtained therewith was so great that special nurseries have been established in connection with the plants of the Deutsch Luxembourg Company and the carbon dioxide gas is pumped directly from the steel plant to the green-houses and sown fields of the nursery. The result has been an increase in plant substance amounting to from 50 to 300 per cent, according to the nature of the plant treated. It is estimated that the gases obtained from the consumption of 1100 tons of coke in the smelting of 1000 tons of pig iron are sufficient to produce 4000 extra tons of edible plant material. If all the gases were used in this manner from an average yearly production of 15 million tons of pig iron in Germany, then the extra yield of food materials would far exceed the present crops.

Aluminum Varnish

IT is well known that a coating of aluminum will protect iron against the action of high temperatures. Many processes have been devised for applying this coating, but they all require the use of special apparatus and exact technical knowledge for their application. During the course of an investigation into the distillation of coal for by-product yield, it occurred to the investigators, according to *Brennstoff Chemie*, 1921, page 343, to attempt to obtain such a coating by using aluminum powder mixed with ordinary rosin varnish. The varnish was made by dissolving one part of rosin in five parts of benzol, and enough commercial aluminum powder was added to give a mass of the proper consistency. The iron parts that were to be coated with this preparation were first carefully cleaned and filed smooth, painted with varnish and then subjected to a temperature of about 750 degrees Centigrade. The organic matter burnt off and the aluminum remained behind on the iron in the form of an absolutely homogeneous uniform coating, which afforded ample protection against high temperatures. This process can be used by anyone and does not require any technical skill to obtain the correct results. It is not advisable to use pure aluminum powder, but the commercial product as that contains a little zinc which has a very beneficial effect.

Utilization of Cotton Stalks

EVERY year there are vast quantities of cotton stalks, burnt up or disposed of in other fashion, in this country and other cotton growing lands. The utilization of these stalks has been discussed in an article, appearing in the *Bulletin of the Imperial Institute*. The investigation has shown that the stalks form a promising material for paper making and that they might be used as well for obtaining acetic acid, tar and charcoal by a process of dry distillation.

New Petroleum Products

PETROLEUM has been occupying the public eye recently in view of official governmental reports regarding the depletion of supply which, it is claimed, is now in sight. J. H. James, in *Chemical and Metallurgical Engineering* 1922 209, does not appear perturbed by this announcement, but has gone ahead and developed some new uses for petroleum by modification of the distillates obtained therefrom to yield oxidation products of particular value. The oxidation is brought about by the proper choice of temperature and with the assistance of catalysts. The products represent all stages of oxidation from alcohols to oxygenated acids. The acidic portion of the oxidation product was separated and treated with caustic soda. The result was a hard resinous mass. The suggestion is made that these resinous substances may be used as cheap varnish gum and paint film substitutes.

The possibility of developing a new fuel from the cheaper fractions of petroleum is also presented by carrying out the oxidation at higher temperatures. Gas oil or residues from cracking stills can be oxidized in this manner and because of the tendency of the oxidized products to decompose thermally and yield substances having a lower molecular weight, which are therefore more volatile, low boiling point mixtures can be obtained which lie within the gasoline range. It is also hinted that the heavier fractions of these oxidized oils may perhaps find use in the lubrication of internal combustion engines. The oxidized oil can also find application in the field of oil flotation.

Radium in Czecho-Slovakia

ACCORDING to the Commerce Reports the uranium ores, which are found at Jachymov in Bohemia, contain large quantities of radium. The known supply will last 20 years at the present rate of production. About two grams of radium are produced each year. Steps have been taken to modernize the present plant and increase the output of the mines.

Our Readers' Point of View

The editors are not responsible for statements made in the correspondence column. Anonymous communications cannot be considered, but the names of correspondents will be withheld when so desired.

A Protest from New Bedford

To the Editor of the SCIENTIFIC AMERICAN

In your January issue of the SCIENTIFIC AMERICAN, on page 39, appears the following sentences

"The chief difficulty with incineration is that the fumes from the burning garbage are likely to create a public nuisance. The City of New Bedford, Mass., recently had an experience of this sort. New Bedford, until recently, disposed of its garbage by reduction, but when the plant began losing large sums of money, an attempt was made to economize by installing a dryer so that garbage could be burned under the digester tank boilers. The fumes inspired such a protest from citizens that the plan was quickly abandoned."

This statement is incorrect, inasmuch that since the dryer has been installed no odors have emanated from the garbage plant. We have been using the chlorine process of disinfection.

Very truly yours,
CHARLES S ASHLEY, Mayor

New Bedford, Mass.

Our Vanishing Forests

To the Editor of the SCIENTIFIC AMERICAN

Your editorial entitled 'Every Man for Himself," published in your August 6th, 1921, issue and relating to reforestation, was interesting reading to all lovers of the woods and especially to those of us who spend our vacations in a forested State of our Union, the Maine woods.

My observation of the timber in this land is that the trees reforest themselves if destructive man with his axe and torch gives them half a chance. For instance, within a mile of this resort (Kineo) there is a lumber camp which is operated primarily for the purpose of getting out white birch for spool wood, but the cutters also take all standing timber that is worth while which comes in their path. The spruce and fir are wanted for pulp, the pine and hemlock for lumber, the cedar for shingles and railroad ties, the black and yellow birch and maple for furniture and veneers. Now, when this section of land has been stripped of its noble forest growth there springs up at once a thick underbrush of mainly cherry The cherry, say the lumbermen, does not grow to any size in Northern Maine, but seems to act as a cover growth of timber which follows—the usual Maine woods forest of spruce, fir, pine, cedar, hemlock—and the birches—some maple and beech.

Nature in its own way has started a forest which may be of value in 100 years, and it is stated that on this very tract of land which is now being scalped of its marketable timber, the present fine stand of white birch is due to the fact that about 100 years ago a devastating fire swept over this region destroying everything burnable in its path. So apparently the Maine woods will reforest themselves—if, as said, man will give them a chance But there lies the danger—will they get a chance with inroads that are being made from modern demands? It is certainly pathetic to see splendid spruces of over 100 years of age stricken by the saw and axe, only to be ground into wood pulp for the consumption of newsprint. Splendid forests are turned into yellow journals or papers that the world would be better off if never printed. Therefore one of the greatest blessings that could come to forest preservation would be to find a new base for paper and stop utilizing noble forest trees for such a base purpose. The SCIENTIFIC AMERICAN has published a number of articles on other means of supplying paper and pulp, but in the meantime spruce and fir is the paper base with all the laborious operations and destructive consequences. Maine, which was once a great lumber State, is now, I believe, primarily a pulp State. *Can't the inventive minds of the country discover a more suitable paper base?*

Another appalling enemy of the forests hereabouts, and, in fact, all forests, is fire. I have heard it stated that this season, owing to the dry weather, there have been something like 200 forest fires in the Maine woods—and within a month two forest fires have been witnessed right from the shores of Moosehead Lake. The fire-fighting service was promptly in action, but before the fire could be put out with the aid of nature (rain) a considerable area of valuable timber had been burned. Ask the fire wardens and lumbermen the cause of the fires and they invariably reply, carelessness with campfires or in smoking tobacco and cigarettes. The cigarette is generally credited with being the best starter of forest fires.

Still another recent enemy of timber has made its appearance in this region. A visitor notices whole mountainsides of dead spruce and upon inquiring the reason is told that the last few years "spruce worm" has settled down in certain sections of this country, eating up the leaves of the spruce and thereby ending the life of the trees. So in addition to man with his axe and torch our forests have to stand the various insect and fungus blights of nature, both domestic and imported, which have about exterminated the chestnut and are now threatening the spruce and pine. So while reforestation and replanting are essential and desirable, is it not also necessary to spend every effort to check the waste and destruction of timber which is going on all over the land, for what is taking place in the Maine woods is going on in other States in different ways? In the Catskill Mountains, State of New York, fine hardwood forests are being cut down to manufacture acid.

Therefore, as well as reforestation we need intelligent regulation and control of Nature's woods if we are not eventually to become the "barren sun-baken hills" of Persia mentioned in your editorial.

Kineo, Maine. PALMER H. LANGDON

Photographing Sound Waves

To the Editor of the SCIENTIFIC AMERICAN

There have been many newspaper and scientific articles published recently concerning the work of foreign inventors in the field of photographing sound waves which do not give proper credit to the several brilliant American inventors in this field, some of whom have recently made additional discoveries which promise much for a great improvement in the reproduction of sound waves recorded or stored on sensitive film by light rays on which the sound waves have been imposed.

The method of recording sound waves by photography has been well understood for many years.

Among the foremost workers in this field was Prof. C. E. Miller at the head of the Physics Department in the Case School of Applied Sciences in Cleveland He first recorded sound waves by means of an open light focused on a sensitized photographic film in 1903, since which time he has made a careful study of the processes and has contributed a great deal to our knowledge of sound waves through the authorship of several standard works, among them "Sound Waves and Their Relation to Music."

Mr H L Falk, then an unknown inventor in New Orleans, La, first recorded sound waves on sensitized glass plates in 1898, and has since and more recently perfected an apparatus for their reproduction

Mr Lewis A Brinkman, then of the Chicago Scientific Institute, succeeded not only in photographing sound waves upon film but reproduced them by means of a selenium cell in 1915 or 1916.

Mr N Tenaka, formerly a citizen of the Flowery Kingdom, who for many years past has been a resident of Medford, Mass., has devoted much time to the solution of these problems and has designed a sensitive light cell which is said to be very satisfactory in its operation, although its composition has not been disclosed. He is endeavoring now to apply it to an improvement in phonographs, and those acquainted with his work seem to think that it will be successful.

The difficulty in the work has until recently been due to the slowness in action of the sensitive light cells produced to date. These were largely composed of selenium and their action or reaction to lights and shadows was not sufficiently fast to carry the rapid vibrations of most sound waves, which vary in the human voice from 1400 to 2900 vibrations per second

Mr Theodore W Case of the Case Research Laboratories of Auburn, N Y, about three years ago succeeded in making a sensitive light cell by the use of thalium, which has since become well known through its adoption by the U S. Naval Department for signalling purposes. About thirty of the naval ships were equipped by Mr Case with signalling devices which employed these cells, and the results of which in actual use have proved very satisfactory He has more recently still further improved these cells by the use of barium instead of thalium, and is still engaged in experimenting along these lines. He has constructed several of these new cells for use in agricultural stations, experimental departments of scientific laboratories, and they are now employed in measuring daylight for lighting companies and other purposes.

A recent official bulletin just published by the University of Illinois announces the perfection of a new sensitive light cell, and says it seems possible that this discovery will make the movies of the future talk, so that there will no longer be the silent drama. The announcement continues: "The scientific discovery is that of an extremely sensitive and reliable photoelectric cell made in the physical laboratories of the University by Prof. Jakob Kunz. The photoelectric cell is a device for turning flashes of light into electric pulses, and is so sensitive that it reacts to light from stars which cannot be seen with the unaided eye."

More recently Mr. Falk of New Orleans, referred to above, and who has become well known through his invention of a liquid glass diaphragm used in reproducers on phonographs, has produced an extremely sensitive and inexpensive light cell by the use of barium. It has been found that these cells are impervious to atmospheric changes and apparently their life is permanent. Tests of these cells show that their response to the action of light is instantaneous. He is now engaged in the work of perfecting instruments and machines for utilizing them, both in phonographs and in moving pictures.

These inventions by Americans, which apparently antedate by several years the work of foreigners, whose work along these lines is just being announced, promise, when properly applied, to solve the problem of the speaking movies and greatly improve, if not entirely revolutionize the phonograph.

X. Y. Z.

Tractor Fuels

To the Editor of the SCIENTIFIC AMERICAN:

Our attention is called to a paragraph headed "Kerosene Not Always the Most Economical Fuel," which occurred on page 463 of your issue for June 11th, 1921. In this connection I should like to quote the results of our tractor tests for the summer of 1920. Under the rules of these tests, tractors are given credit only for the power delivered to the dynamometer, in brake-horsepower tests. The fuel economy of the 65 tractors tested, when loaded approximately to the rating given by the manufacturers, may be summarized as follows:

Of 53 kerosene tractors tested, the lowest showing in horsepower-hours per gallon was 4.85, the highest, 10.82, the average, 7.658. Of twelve gasoline machines, low, high and average figures were, respectively, 5.43, 8.52, and 6.976. Ten kerosene tractors had a better performance than the best record made by a gasoline tractor, and that their advantage was so pronounced that the average of the first thirty kerosene machines beat the best individual gasoline-tractor record With our reports going out broadcast, it seems surprising that a contributor to the SCIENTIFIC AMERICAN should present results so widely variant. The figures given in your article approximate in some respects those of our draw bar tests; but if this be the source of the error, draw bar records have been compared directly with brake records. It seems incredible that a reliable contributor would make such a comparison.

It may be of interest to note that 1921 tests show four gasoline tractors better than 1920's best. The high figure is 9.81 horsepower-hours per gallon, no allowance being made for belt loss or for loss between engine and pulley

E. E. BRACKETT.

University of Nebraska.

Loading Stations No Novelty in Illinois

To the Editor of the SCIENTIFIC AMERICAN:

I note in your November number an article on page 47 about "A Farmers' Loading Station" The description treats this as a new or unique establishment. Perhaps it is in California, but here in Illinois we would no more think of taking grain to market in sacks or bags than we would of cutting wheat with a cradle, and loading stations, or elevators, as we call them, are as common as stores; there are thousands of them in this state. Of course, they are of all sizes and kinds. Some of them are novel. For instance, at Sibley, Illinois, there is a corncrib, or rather corn warehouse and elevator, that has room for the storage of 150,000 bushels of ear corn. There may be other plants of this kind in the country, though I have never heard of any that were equipped in anything like the manner this one is. But loading stations are no novelty, and grain sacks are used only for clover and timothy seed or other grains sold in small quantities. L. S. ASHLEY.

Paxton, Ill.

The Psychology of Reading

To the Editor of the SCIENTIFIC AMERICAN:

A few months ago I read an interesting article concerning correct reading. The author pointed out the fact that most people limit their rapidity of reading by mentally repeating each word, instead of grasping the thought in each word structure at a glance. Is it not possible that a lack of standard printing practice has prevented most of us from developing the proper coordination of sight and mind necessary to make this kind of reading possible?

To illustrate, the text books supplied for our schools show a variety of type size, spacing, and column widths. It is not surprising that students who are taught from such literature seldom become really adept in the art of reading. Imagine trying to learn to operate a typewriter if one was forced to practice on several different keyboards. Our newspapers have developed a fairly uniform style of printing, and from my own observations, I believe that most people can read newspapers more rapidly than other literature.

Some one could certainly do the people a service by determining, through psychological research, the most advantageous kind of printing and then forcing publishers to accept it as a standard.

PAUL D. FLECK.

Ironton, Ohio.

Recently Patented Inventions

Brief Descriptions of Newly Invented Mechanical and Electrical Devices, Tools, Farm Implements, Etc.

Pertaining to Aeronautics

SHEATHING FOR AIRPLANE PROPELLERS.—T F HAMILTON, Hamilton Aviation Field, Milwaukee, Wis. An object of the invention is to provide a construction in airplane propellers whereby the metal sheathing is prevented from buckling, due to the flexing of the propeller blade when driven at a high speed, and also whereby the accumulation of water, especially at the outer extremity of each blade tip, is prevented.

PLANE FOR AIRCRAFT.—J F BRICE, 60 Wall St., New York City, N Y The invention aims to provide improvements in aircraft, utilizing lifting surfaces commonly termed "aerofoils." An object is to provide a construction which will be capable of a far greater amount of speed with the same engine power without in the slightest effect ing its lifting qualities. A further object is the construction of a device in which a given area will exert a far greater amount of "lift" than has hitherto been possible.

FLYING MACHINE.—F G HANEY, 915 W 8th St., East Liverpool, Ohio The primary object of this invention is to provide a flying machine which is capable of rising and descending in a vertical line. A further object is the construction of a machine which will incorporate certain mechanism permit ting it to move at a tangent to both the hori zontal and vertical, as well as the horizontal, and in which the course of the machine may be readily guided through the air

FLYING MACHINE.—A L. MARPLE, General Delivery, Narrows Park, Cumber land, Md. The invention is particularly designed as a land and air vehicle for carrying passengers through the streets of a city, or to distant points through the air The con struction is such as to permit of its being partially folded when in the streets or in storage, and when traversing the air is adapted to be extended to its full capacity so as to properly function as an airplane It is constructed also for safe landing and departure from water, and permits of safe traveling through the water as a hydroplane.

Pertaining to Apparel

GARMENT SUPPORTER.—J P WILSON, 1125 Francisco Ave., Francisco Apt. No. 4, San Francisco, Calif An object of this invention is to provide means whereby the tab carrying the button cooperating with the clasp will not become quickly worn or detached from the supporting means. The support includes a tape and clasp provided with a hinged tongue, said clasp presenting a plurality of openings, the tape being threaded through the openings and around the point of the hinged connection, and a button secured to the outer end of the tape adapted to cooperate with the tongue of the clasp.

BUCKLE.—A. J WOOD, R. F D No. 8, Box 58, Birmingham, Mich This invention relates to trouser supporting means, for en gaging the top button hole of the fly or front portion so as to prevent sagging of the trousers as well as the belt at this point. The buckle is provided with a hook or like device adapted to support the trousers, but will in no way interfere with the buttoning or unbuttoning of the trousers or usual work ing of the belt.

GARMENT.—B. LUSTGARTEN, 2233 80th Street, Brooklyn, N Y The invention relates to garments of a bifurcated type One of the objects is to provide a combination closure for the lower end of the leg members, by means of which the open end may be used in its full open position or may be drawn by means of a drawstring to provide a closure of the bloomer type

GARMENT FASTENER.—A ROCKE, 859 Beck Street, Bronx, N Y An object of this invention is to provide a garment fastener more especially designed for use on corsets and similar garments and arranged to permit the wearer to readily close or open the corset and without danger of the corset becoming accidentally open after it is closed A further object is to permit of applying the fastener to various types of corsets without requiring essential changes in the construction thereof

TIE HOLDER AND RETAINER.—M W REESE, 3216 Myrtle Ave Omaha Neb The invention has particular reference to a necktie holder and retaining device for use in connection with soft collars. The principal object is to provide a tie former and holder which will closely stimulate a hand tied tie, including means for fastening the same to the wings of the collar which means may simulate any one of a number of fastening devices in general use

Chemical Processes

PROCESS OF THE PRODUCTION OF AROMATIC ALDEHYDES AND THEIR SUBSTITUTION DERIVATIVES.—C O BENEDETTI and A P and W VANSLOW, c/o Chocolate Products Co Pratt and Con cord Sts., Baltimore, Md The invention relates to a process and apparatus for the pro duction of aldehydes and their derivatives and has reference more particularly to the monohalogen derivative of the corresponding aromatic hydrocarbon or its substitution derivative which is hydrolyzed by an aqueous alkali solution to the corresponding primary alcohol, and this alcohol is then oxidized to the aldehyde by means of a hypochlorite solu tion

PROCESS OF PRODUCING TITANIUM NITROGEN COMPOUNDS.—F VON BICHOWSKY and J HARTHAN 1412 San Fernando Blvd, Glendale, Calif The in vention relates to a process of producing titanium nitrogen and the like compounds from such minerals as ilmenite and one of the important features resides in the recovery or production of such compounds by heating ilmenite with an agent such as car bon and in the presence of an agent such as nitrogen, at a temperature of about 1100° C

Electrical Devices

ELECTRICALLY HEATED PRESSER FOOT.—HETTIE E. RUDOLPH Box 3484, Lowell Ariz. The object of the invention is to provide on the presser foot of a sewing machine an electric heating attachment so that the presser foot serves, in addition to its ordinary function the function of an iron to press seams, hems, pleats, tucks, etc., as they are being stitched on the machine (See Fig 1)

SHAVING BRUSH.—J C PAGE 1105 Mission St, San Francisco Calif Among the objects of the invention is to provide a self feeding and electrically heated shaving brush that is convenient to handle ready for use almost instantaneously after turning on the heat, can be regulated as to the amount of soap to be fed into the brush, and can be conveniently carried along in a suitcase

ELECTRIC FIXTURE FITTING AND METHOD OF MAKING SAME.—D GOTTICH c/o Arrow Tool Mfg Co Bridgeport, Conn The invention has particular reference to a form of hickey An object is to provide means by which the fitting is simply and efficiently formed from a single piece of sheet metal, and which in its com pleted state presents a finished appearance, whereby smooth edges and surfaces are pre sented, so that the insulation is not worn out by contact with rough fittings

LOCK.—D HOFFMAN and F LASTON, address D H F Dubbon 193 Third Ave New York, N Y The aim of this invention is to provide a device more particularly adapted for use in connection with an elec trical circuit of an automotive vehicle but not necessarily limited to this adaptation, and by means of which it will not be neces sary for an operator to utilize a key to complete closing and opening of the circuit A further object is to construct a lock in which an alarm will be given upon an un authorized person endeavoring to manipulate the same

Of General Interest

WASTE FUEL OIL SALVAGING BARGE.—H M FACKERT, 400 W 23rd St. New York, N Y An object of this inven tion is to provide a means for expeditiously separating fuel oil from water as the same is discharged from the tanks of oil burning vessels A further object is to provide an apparatus which automatically operates to receive the mixed oil and water separate the same discharge the water and retain the oil The apparatus is inexpensive to operate and highly efficient in its purpose. (See Fig 2)

KITCHEN CABINET.—W M GAILAGHER, 215 State St, Litchfield Ill The in vention has for its object to provide a device which has a relatively great capacity being adapted to hold a large number of utensils, which permits of access to any particular article without the necessity of removing or displacing any of the other articles contained in the cabinet, which is convenient, simple and durable, attractive in appearance, sani tary in use, and inexpensive to manufacture.

ATTACHMENT FOR COLLAPSIBLE TUBES.—J S TURNER, address Turner White Metal Co 218 Raritan Ave., New Brunswick, N J This device is designed to produce a closure and spreader for use with collapsible tubes, more especially those con taining glue The glue of collapsible tubes tends to harden at the neck, making an irregular seat for the closure, whereby leakage is liable to result as well as hardening of the tube contents. The device includes a threaded zone on the shank of the spreader, the ar rangement being such that a tight closure is effected and no mutilation of the threads in the neck or disruption resulting from the re peated insertion and removal of the spreader (See Fig 3)

HAND BAG.—A KUTICK c/o Elk Leather Goods Co, 130 W 29th St, New York City, N Y This invention relates to hand bags having an interior main pocket and in terior side pockets on opposite sides of the main pocket The object is to provide a hand bag which is exceedingly simple to manufac ture and without seams in the body and to render the bag very durable and neat in ap pearance

RAT TRAP.—J F KELLER Box 23 Ottoville Ohio An object of the invention is to provide a trap in which the bait is positioned upon a hinged platform equipped with a novel form of trigger mechanism which will quickly operate the trap door after the rat has entered A further object is to provide a trap which may be easily kept clean, which is strong simple, and efficient in use, and which will be comparatively inexpensive to manufacture (See Fig 4)

FINDER.—F A WENMAN 348 1st St Brooklyn N Y This invention has reference to such finders as are used in connection with photographic instruments The primary object of the invention is to provide a finder which may be accurately adjusted for both horizontal and vertical planes, and which is so arranged that camera lens may be moved to register into a position which will permit of a reproduction of an image within the camera corresponding to the area included within the field of the finder

METHOD FOR PRODUCING WOOD FLOUR.—T J CUNNINGHAM 5 Horicon Ave., Glens Falls N Y The invention relates to a wood flour such as is used in the manufacture of phonograph records and other articles. The object is to provide a method for producing wood flour from raw sawdust the method consisting essentially of screening the sawdust grinding the screened sawdust under development of heat to vapor

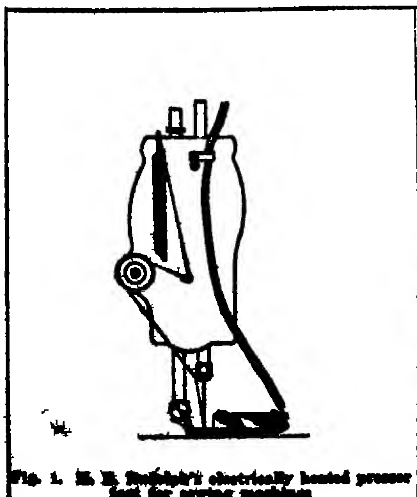


Fig. 1. H. E. Rudolph's electrically heated presser foot for sewing machines

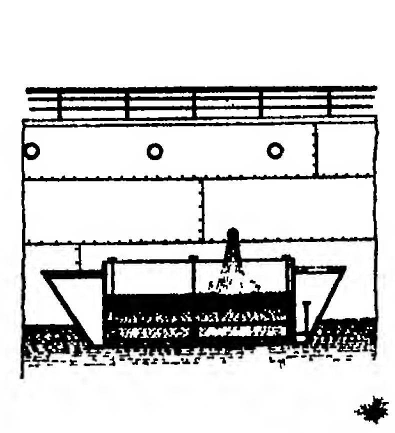


Fig. 2. Barge for salvaging waste fuel oil, patented by H. M. Fackert

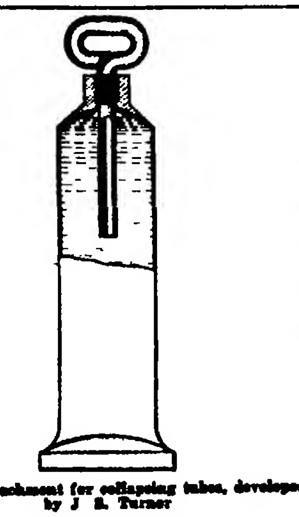


Fig. 3. Attachment for collapsing tubes, developed by J S. Turner

Fig 4. J F Keller's rat trap with novel means of springing the trigger

ize the moisture, and bolting the sawdust to separate the coarse from the wood flour

SWING.—W. L. BRAYMER, Box 444 Kiefer Okla. The object is to provide a foot rest for so-called porch" swings, the rest being so constructed that it may be readily attached to a standard type of swing. A further object is to provide spring means in connection with the rest which will permit the same to lower when the user places his feet thereon preparatory to entering the swing

DISPLAY CARD.—J. DOMBER, 93 Franklin St., New York N Y. This invention has for its object to provide a display card which may be utilized by dealers or in window display, and by means of which a piece of cloth may be presented in such manner as to more nearly conform to the appearance of a completed garment, although the card may readily be utilized as a cover plate for the folder receiving a number of pieces of cloth one of the pieces being shown in the manner described

DISPENSING DEVICE.—I. W. TIFFANY, Winsted, Conn. The invention aims to provide a device of this character more particularly adapted for use in connection with pins, paper clips, etc. A further object is the construction of a device by means of which the pins or clips may be readily withdrawn and which shall also present an extremely neat appearance

EGG BEATER.—H. G. TEETSELL, 45 John St. Tarrytown N Y. The primary object of the invention is to provide a form of handle for egg beaters which is offset and will thus do away with the disadvantages commonly found in devices of this nature among them the scratching of the operator's knuckles on the gear wheel and the inability to see just when the material has been stirred in cases where small quantities of material are used

REPOURING ATTACHMENT.—J. P. QUINN, 157 St. Anns Ave New York N Y. The invention aims to provide an attachment for use in connection with percolators which are utilized for the percolating and dispensing of beverages in restaurants and like places. The object is to provide an attachment by means of which the operator may readily effect a withdrawal of fluid from the base of the receptacle and a reintroduction of the same at the upper end of the receptacle, without splashing or injury to him self

FLEXIBLE BRACELET.—W. MAGUIRE and A. BAUSCH, address A. Bausch 822 Flatbush Ave Brooklyn N Y. The invention has for an object to provide a bracelet box and connecting means wherein the various boxes or parts of the bracelet are articulated slightly in a simple and effective manner, and in which upstanding bendable lugs are presented for receiving coupling rings so that when encircling two lugs a pivotal hinge connection will be provided

ADVERTISING DEVICE.—H. K. MACDOUGALL c/o Y M C A Tientsin China. The general object of the invention is to provide a mount for the advertisements disposed longitudinally of a car beneath the roof in the customary position of such advertisements and having means to intermittently turn the advertising mount about its own axis through the medium of a fan adapted to be turned by wind pressure due to the motion of the car

REFRIGERATOR.—W. L. HUMMEL, 2011 N Richmond St Chicago Ill. An object of this invention is to provide a refrigerator having a plurality of compartments and provided with means operable to permit air to circulate freely from one compartment to another when the compartments are closed and to prevent the passage of air from any compartment to the adjacent compartment when the door of that particular compartment is opened

COMPENSATING DEVICE.—G. O. GRAY Box 234 Butte Mont. The invention has for its object to provide a device of the character specified especially adapted for use with chart display apparatus, for compensating for difference in speed due to the unequal size of the rollers while the chart is winding from one and winding on to the other

PAVING BLOCK AND PROCESS OF MAKING THE SAME.—J. S. DOWNARD, 1615 American Exchange Bank Bldg Dallas, Texas. The invention relates to paving blocks used as a wearing surface upon a suitable base or as a pavement without a base other than the block itself. The process consists of mixing particles of natural asphalt rock with a mastic consisting of rock asphalt powder pure asphalt, and a substance having a high melting point, introducing the mixture into a mold to form blocks, and subsequently cooled with water

CATAPULT AND PROJECTILE THEREFOR.—C. E. TIEDEMAN, 25 W Fulton St., Gloversville, N Y. The purpose of this invention is to provide a catapult of extremely simple construction, which is manually operable to impel a ring like projectile in different velocities and in such manner as to maintain the projectile in upright position during flight. A further purpose is to provide a projectile constructed to permit of its looping a target and causing its adherence thereto so that the accuracy of the shot may be determined.

BEDSTEAD AND OTHER FURNITURE.—S. B. GAMBLE West Perth, West Australia Australia. The invention relates to a dovetail fitting formed of sheet metal, which may be used in the joints of bedsteads and other articles of furniture, an object is to provide a fitting of this kind particularly applicable for connecting the frame of a spring mattress with the usual wooden bed posts

SOUNDING DEVICE.—V. H. CONLEY, 3615 Bernard St Chicago Ill. The object of this invention is to provide a sounding device to take the place of what is commonly known as a lead line such device being adjustable to the work to which it is to be subjected. The device includes a blade, pins secured to and extending outwardly from the blade and being adapted to lie at an angle to the direction of travel. By this device it is not necessary to slow the speed of the vessel

METHOD OF FIXING COLOR MARKINGS ON THERMOMETER STEMS.—H. T. KRIGHT, c/o Verstendig 766 Grote St Bronx N Y. The invention relates to the manufacture of high-class clinical thermometers and includes means for fixing the markings on the stem by firing the marking being first applied through the medium of a vitrifiable color which will fuse when subjected to the heat of the firing kiln. Means are provided for keeping the mercury bulb sufficiently cool to prevent such expansion as will cause fracture of the instrument

AUTOMATIC FIRE ALARM.—C. A. ANDERSON 803 Coulmont St. North Braddock Pa. The object is to provide a device adapted to be moved around from place to place at various locations within a residence factory or mercantile establishment wherever there seems to be a special source of danger. The initiating cause of the alarm is a form of thermostat and consists of metal plates adapted to be warped from a normal arrangement by a rise in temperature

MONOLITHIC WALL.—M. J. GRAHAM, 1927 Calder Ave Beaumont, Texas. Among the objects of this invention is to provide a monolithic wall of simple inexpensive construction in connection with which both the inside and outside surfaces may be similarly formed and ornamented as desired, as well as one which will be strong and durable and is capable of easy and quick formation

HAME AND TRACE CONNECTER.—F. H. HARWOOD Box 156, Stevenson Wash. The purpose of this invention is the provision of a device for connecting a hame and trace formed of rope which eliminates the necessity of splicing the trace and permits of the longitudinal adjustment of the trace while at the same time securely maintaining it in adjusted position without subjecting it to any appreciable degree of wear

PRINTER'S SLUG AND RULE.—W. E. TAYLOR, 202 W 20th St New York N Y. The invention relates to slugs and rules and molds therefor to produce slugs and rules in strip form. The slug as invented by this patent includes a solid body portion having a plurality of parallel openings extending from one end to the other, and the material between said openings forming a longitudinally extending strengthening web.

ROAD CONSTRUCTION.—G. H. PADGETT, 716 N A St., Edwards, N Y. The primary object of this invention is to provide a track or wearing rail in roadways on which vehicles may be driven, and to so construct the track that it may serve as a means for draining the road, thus helping to maintain the road in good repair

COMPUTING DEVICE.—G. D. JOHNSON, address Mrs. G. D. Johnson, Administratrix, 3709 3d Ave, Bronx, N Y. The invention relates to a device for computing weight per square foot of leather belting. An object is to provide a mechanical device comprising parts bearing scales having certain relations so that by setting certain parts at certain relative positions the weight in decimal ounces, the total weight of the roll being known, is indicated upon the device without the necessity of the use of additional calculating instruments.

SPRING PAD.—S. S. MARCUS and S. KRAKAUER, 1780 Morrison St., Bronx, N Y. This invention has for its object to provide a spring or cushion pad which is simple in construction, cheap to manufacture, and arranged for convenient insertion in a casing in any desired number of units. Another object is to permit of conveniently forming the pockets in pairs for corresponding pairs of springs.

WALL CONSTRUCTION.—D. J. FLYNN, 222 Elm Court, Elizabeth, N J. The object of the invention is to provide a wall construction formed of hollow building blocks arranged to compensate for any irregularities in the blocks when building the inner and outer wall sections and tying the same together. Another object is to provide a block capable of use as a whole, or to be split by the mason as desired

METHOD AND MEANS FOR PRINTING.—L. E. WOODWARD, 6300 Montgomery Road, Cincinnati, Ohio. This invention is particularly intended for the printing of theater tickets, by means of a cylindrical printing plate composed of half sections produced by setting up the type in separate chases with parallel lines, the matter in the lines of one chase running continuously with the corresponding lines in the other chase, and forming semi-circular matrices, the plate formed from which will present the printing elements in a continuous spiral

TRAP.—T. R. SCHUERMANN, The Rexall Store, 209 Green St., Chenoa, Ill. The invention relates to traps for catching rats, mice and other rodents. An object is to provide a sheet metal trap construction, including two compartments for retaining the rodents, until it is desired to empty the trap or immerse the same the trap being provided with a removable bait holding device which will attract the rodents, but will prevent their access thereto for eating the same

LEG BLOCK.—S. BATTAGLIA, 52 Beaver St., Brooklyn, N Y. The primary object of the invention is to provide a leg block for use in connection with furniture construction, which will serve to firmly retain the leg in its proper position. A further object is to provide a leg block which may be applied in a minimum of time, and in which any play which may come into being may be readily compensated for so as to again firmly affix the leg

HOLDER FOR GROWING PLANTS.—P. KUEHFER and O. NIEDERBERGER, 1024 Bryant Ave., New York N Y. The invention relates to plant holders and more particularly to a receptacle for growing plants, which is especially designed for indoor use. The device is so constructed that air is permitted to enter the soil contained in the receptacle which is formed with slats, which at the lower portion form drainage space when the plant is watered the unabsorbed water being caught by a drain pan

WRISTLET.—I. P. KELLY 207 Eighth Ave New York, N Y. The primary object of the invention is to provide means adapted to be worn upon the arm of the operator to catch the drip from a sponge, cloth or other washing implement in washing painted surfaces, windows and the like. The device is so formed that it may be readily attached to or detached from the operator's arm

TRIPOD FOR MACHINE GUNS.—J. F. O'MALLEY Box 323, Mount Vernon, N Y. This invention has for its object to provide a tripod for machine guns arranged to enable the gunner to sight the gun quickly and accurately and to hold the same securely in adjusted position during the firing. Another object is to permit of firmly setting up the tripod on soft or rocky ground

ARTIFICIAL HAND.—R. F. ARMSTRONG La Cygne, Kansas. The object of the invention is to provide an artificial hand which is capable of readily and easily performing all of the important functions of the human hand, and which is of extremely simple and durable construction, reliable in operation and easy and inexpensive to manufacture.

TICKET CARRIER.—H. RUSCHER and O. S. PAYZANT, c/o O. S. Payzant, 70 East 45th St., New York, N Y. The invention has for an object to provide a carrier wherein the tickets are not only held at a proper angle for dispensing, but are prevented any appreciable reverse movement when pressure is brought to bear thereon preparatory to their removal. A removable spring is arranged at the discharge end to resiliently resist removal of the tickets.

DEVICE FOR HOLDING MATRICES IN STEREOPLATE CASTING BOXES.—C. WINKLER, Berne, Switzerland. The purpose of this invention is a device for holding matrices which is opened, for the purpose of putting in the matrix, and then closed, for holding the matrix by means of a worm gear, the device holding the matrix will remain in position when opened, thus enabling both hands to be used for manipulating the matrix.

COIN STACKER.—P. F. FRIESEN, First National Bank, Hillsboro, Kans. An object of the invention is to provide an inexpensive device into which coins can be readily placed and which will by gravity stack the coins and indicate the number or value of the stack. A further object is to provide a stacker which may be used for stacking coins of different sizes by substituting different inner tubes.

REPRODUCER.—V. C. HOLLAND, address W. H. Watson, Keene, N H. An object of this invention is to provide a reproducer having a diaphragm of cotton fiber suitably treated with chemicals and vulcanized to give it the necessary reproducing qualities, and which will enable a larger diaphragm to be employed than with materials commonly used, and will operate not only to more perfectly reproduce sound, but dispense with the defects in the sound due to engagement of the needle or stylus with the record

SHOE.—L. C. KENYON, 622 Market St. Chattanooga Tenn. This invention relates more particularly to the making of shoes of the blucher type, for children's use, having a double tip and vamp portion to provide a smooth interior surface such as to obviate the necessity of a lining for the shoe at the forward part, so that the lining may only be disposed in the top part of the shoe and thus have the appearance of a drill-lined shoe.

STRIPPING COMB.—M. J. COLLINS, 1125 Park Ave., New York, N Y. The object of the invention is to provide a stripping comb, such as is used in the grooming of rough-coated terriers, in preparing the dogs for exhibition, by means of which an operator will at all times have an instrument available which will be in perfect condition for use, in that the cutting edge may be readily sharpened, and the comb readily and quickly cleansed

SCALE.—J. E. BURTON, 140 A Hamilton St. Cambridge, Mass. An object of the invention is to provide a scale which may be installed in the ice-box of a refrigerator and which will occupy a comparatively small space. A further object is to provide a scale which will automatically register the amount of ice deposited, and enable a housewife to see just how much ice there is in the box at any time.

DECORATED ARTICLE.—A. N. EPSTEIN 23 Judge St Brooklyn N Y. This invention relates to articles of wood, metal, vitric ceramic, fibrous or textile fabrics, and its object is to provide an article having a highly ornamental and effective glass bead or crystal decoration. Another object is to permit of producing a surface ornamentation which is not effected by changes in temperature or by moisture, and is not liable to peel off, crack or become injured

DETERGENT.—O. M. WEIGLE, 600 Jefferson St., Fulton Mo. Among the objects of the invention is to provide a detergent for cleaning the hands or body which will have a high efficiency, will be cheap to manufacture, and will leave the skin soft and in good condition, it is especially useful as a cleansing agent for the hands when they become very dirty. The composition consists of cornmeal, 85 per cent, powdered soap, 14 per cent, and boracic acid, 1 per cent.

PENCIL CLIP.—J. R. FITTON, c/o C. E. MORSE, 511 West 60th Street, Chicago, Ill. Among the objects is to provide a simple clip that is adapted to be applied to a pencil or pen casing and which has means for engaging with the fabric of a garment, whereby the pencil is effectively held against movement relative to the garment. A further object is to provide a pencil clip that is practical commercially and inexpensive to manufacture.

HATPIN.—A. C. CLAUS, c/o Edgar Freed, Mohawk Bldg., Portland, Ore. The purpose of this invention is to provide a hatpin, for ladies' hats, which is extremely simple and of inexpensive construction, which can be readily applied to the hair and hat for securely retaining the hat to the hair, and at

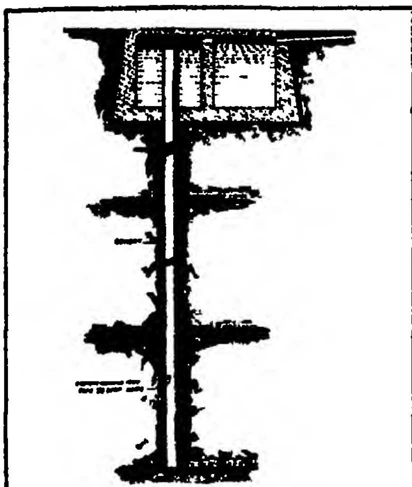


Fig 5. W J Snively's system of drainage and disposal of offensive wastes

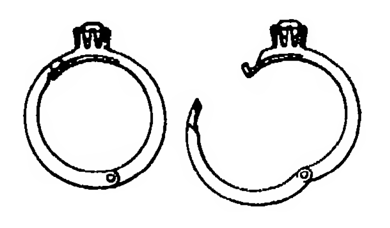


Fig 6. Finger ring that does not have to go past the knuckle invented by D P Fontana

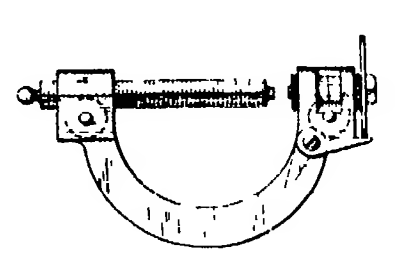


Fig 7 Micrometer calipers that takes the place of several tools, patented by G Cousins

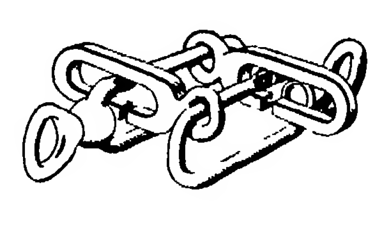


Fig 8. Quick-operating cable coupling put out by J W H Blee and A P Powell

the same time permitting the ready withdrawal thereof when removing the hat.

DRAINAGE SYSTEM —W J SNIVELY, address W J Hunter, Main St., Greensburg, Pa. The invention particularly relates to a drainage system whereby sulphur water and all objectionable waters that flow from coal mines into creeks and streams, can be gotten rid of, the same system may also be applied to dry up swamps and marshes. The object is to drain the water to a sedimentation chamber, and from there carry it by pipe drilled into the ground to a depth of the third water level, thus preventing the pollution of the upper water stratas. (See Fig 5)

FINGER RING —D P FONTANA, 314 W 10th Street, New York, N Y Among the objects of this invention is to provide a finger ring construction in which the ring body is formed of hingedly connected sections which permit of the opening of the ring during its application or removal By this method it is not necessary, as in a solid construction, to make the internal diameter of sufficient size to readily slip over the knuckle, which so often results in a loose fit. (See Fig 6.)

Hardware and Tools

MICROMETER CALIPERS —G COUSINS, c/o C W Dings, 173 W 1st St Oswego, N Y The chief object of this invention is to provide a readily adjustable and easy reading device, which will obviate the necessity of possessing 2-inch, 3 inch 4-inch, etc., of the ordinary forms of micrometer calipers, the length of the regularly serrated bar limiting the extent of its application Its simple construction for rapid adjustment, and absence of delicate parts, render the caliper a most desirable addition to unskilled, or expert machinists' kits. (See Fig 7)

VISE.—J R. MARTIN, 132 W 16th St., New York, N Y The invention relates to work holders used on planers, shapers, milling machines and other metal working tools. The object is to provide a vise or workholder arranged to accurately seat the work on the base of the vise without requiring hammering the work down by the operator Another object is to permit of applying the device to vises as now generally construed.

CABLE COUPLING.—J W H BLEE and A. P POWELL, Box 426, Harrison, Idaho. The purpose of the invention is to provide means by which a rapid coupling and uncoupling of two lengths of cable can be effected without the possibility of the coupling being accidentally uncoupled The device comprises companion coupling members, each comprising a connecting link and a coupling link permanently and slidably connected, each of the coupling links being detachably associated with the connecting link of the other coupling member (See Fig. 8.)

SELF-ALIGNED INSERT —W W WHITE, 93 Halsey St., Brooklyn, N Y The invention has particular reference to metallic or other inserts used in connection with concrete or cementitious body portions. An object is to provide a simple, economically manufactured, compact insert which when placed within a mold to be embedded in a concrete body portion aligns itself properly and maintains its alignment thereafter

VISE.—L. POSCH, 201 Odgen St., Jersey City, N J. The object which this invention has in view is to provide a gripping structure for vises and other mechanism which will grip articles of different sizes and shapes and will at the same time accommodate itself to the particular shape of the article to be gripped Another object is to provide a gripping jaw formed with a number of nested parts which will automatically assume a straight line or an irregular line as pressure is brought to bear thereon

HACK SAW —J SIDDON, 110 Melchon Place, Joliet, Ill An object of the invention is to provide a hack saw in which the use of adjusting screws to hold the saw blades is obviated A further object is to provide a device that has means for holding a saw blade in either vertical or horizontal position and to provide means for holding saw blades of various sizes.

GUIDE OR GAGE FOR RECIPROCATING HAND TOOLS —H BRIGGS Hasbrouck Heights N J Among the objects is to provide means whereby the operation of the tool is rendered more positive, to provide means whereby the handle may be locked to the tool to prevent its accidental disconnection, and to provide a handle which may be adjusted to the plane of the tool forming a convenient hand hold at the forward end of the tool and assisting in its manipulation

DRAWING INSTRUMENT — S HOFFMAN J SCHWARTZ and I HOLDEN address M Lavitt, 256 Broadway, New York, N Y This invention relates to what is known as an ellipsograph, and has for an object to provide a construction wherein by a quick adjustment different forms of ellipses may be drawn A more specific object is the provision of an ellipsograph formed on the general principles of a compass with an adjustable guide arranged to guide the scribing member for producing ellipses of different sizes and shapes

VISE —T SZYLDEROWICZ, 832 E. Rau St., Shamokin Pa An object of this invention is to provide a vise, and to provide the jaws of the vise with conical extensions said extensions curved in cross-section and tapering to their outer ends so that wire or other device can be conveniently bent around either or both of the extensions and the bend be given the desired arc, coil or curvature by reason of its location between the extensions.

WRENCH—B. G PATTERSON, 408 Tradesmen's Bank Bldg, Oklahoma City, Okla The invention has for its object to provide a wrench which may be quickly and easily adjusted to operate upon various objects, which is automatically locked in adjusted position which may be readily released, and which is of simple and durable construction, reliable in operation and easy and inexpensive to manufacture

COMBINATION LOCK —R. ELCOCK, Victoria Mansions, Eloff St. Johannesburg, Transvaal, South Africa The invention relates to locks in which movement of the bolt is dependent upon a prescribed positioning of rotatable letter rings or movable numbers. An object is to ensure that no opening movement of the bolt can occur until all the gates of all the movements are alined, thus preventing the position of the gates being felt individually

SUPPORTING HOOK.—T H RYAN, 116 Peshine Ave., Newark, N J The invention aims to provide a device commonly known as a "pot hook." The primary object is to provide a supporting hook adapted for use by painters or other mechanics, and by means of which the bail may be readily attached and detached therefrom, and the device readily attached to the supporting member, such as a ladder from which it is to be suspended, yet when attached will reduce the liability of its accidentally becoming detached

SURVEYOR'S INSTRUMENT AND RANGE FINDER —J CASERANI 2200 Leatherwood St., Butte, Mont. An object of the invention is to provide an apparatus which is extremely simple in construction, and easy to operate without the employment of complex mathematical rules. A further object is to provide a plum level attachment which serves to determine easily and accurately the amount of elevation or depression from the horizontal of any stated point

TWIST DRILL —F A JOSEPH Princes Bldg Hong Kong, China The invention has reference more particularly to twist drills whose cutting edges are irregular in scribed outline so that the cutting edge of one flute of the drill leaves zones of metal in the hole which are cut by the cutting edges of the other flutes of the drill An object is to provide a drill from which the swarf or chips will be easily cleared

POCKETKNIFE. — P W HALLVARSON, Black Diamond Alberto Canada The main object of the invention is to reduce the cost of producing a knife of this character by constructing the handle from a single sheet of material which is stamped to provide the blade receiving compartment, which will be extremely rugged, whereby the same will withstand hard usage

COMBINATION TOOL —M R KRONERT, 443 W Chicago Ave, Chicago Ill The invention relates to a combination square, level and device for indicating the position of a piece of work having a circular wall relative to a milling cutter or the like in order to properly mill a key seat or the like in the work, and to insure the proper engagement of the cutting tool with the work to mill a slot or the like of a given size

WRENCH —J J THOMAS, Box 153, Balfour, N D An object of this invention is to provide a wrench with means operable to releasably and firmly maintain the gripping parts in adjusted position and means for gripping non-circular articles and also objects circular in section when the handle is swung in one direction and to release the object when swung in the opposite direction

CHAIN TONGS —C ASHMUSEN 3 Fulton Street, Albany, N Y The object of the invention is to provide pipe tongs having gripping means which conform to the shape of the pipe pivoted to the lever arm and supplying in conjunction with the gripping means, means for connecting the free end of the gripping means to the lever arm and for locking the connecting means in engagement with the lever arm

HINGE ANCHOR FOR TOILET SEATS —G C DOBSON, 4547 Park Ave, New York, N Y The object of the invention is to provide a hinge anchor for toilet seats arranged to securely and firmly connect the seat with the hinge to allow proper up and down swinging of the seat without danger of injuring the seat or the hinge post. The hinge is simple, durable, and not liable to get easily out of order

LOCK —B GREENISON 171 W 71st Street, New York N Y The invention relates to a lock construction which will serve to reduce the risk of an unauthorized person opening the closure, to a minimum An object is to provide a lock, the appearance of which is no different from that of a conventional lock which an unauthorized person would be led to believe that a skeleton or master key would open but which cannot be opened without a special form of key

WRENCH —J C MAHAN 2304 Washington St Lincoln, Neb This invention has for its object to provide a wrench especially adapted for twisting together wire cables in woven wire fences, and drawn cables around the end and corner posts The head consists of sections detachably connected and adapted to embrace the wires together with pivotally connected members having jaws for rotatably engaging the head said head and jaws having interengaging means for constraining the head to turn in one direction when the jaws are vibrated

SAW RELIEVING DEVICE —M H MCCORMICK Benford Texas The invention relates to a device by means of which the corners of the gullet between the teeth of a saw are operated on The device may be conveniently associated with a sharpening machine A further object is the construction of a device which shall operate upon each side of the saw upon the corners of the gullets, as the saw is moved through the device

COMBINATION CURTAIN AND SHADE HOLDER —T W MORR, 800 N 11th Street, Springfield, Ill An object of the invention is to provide a light metal combination curtain and shade holder for windows, having adjustable shade brackets adapted for operative engagement with window shades of various lengths, said holder being quickly and easily adjusted to accommodate shades of various sizes and curtains of various widths.

Heating and Lighting

FIREPLACE — J E LANGFORD Kin Kin, Cooran Queensland Australia The invention relates to a form of fireplace devised for the purpose of heating two rooms with one fire and has for its object the attainment of economy in fuel, economy in construction, economy in labor of attendance safety in use and also the convenience of permitting the fire to be left burning when it is so desired

BURNER —F E CORNWELL and J H MCCREADY 622 E 6th St Okmulgee, Okla The inventors have been granted two patents on gas burners of a similar nature The inventions relate more particularly to gas burners adapted for return tubular boilers and stills. The object is to provide a burner which is of simple and durable construction reliable in operation and inexpensive to manufacture and apply, and which provides for a thorough uniform mixture whereby the fuel is completely consumed and a maximum amount of heat evolved

WATER HEATING ATTACHMENT M STARR, 510 West Third St. Plainfield N J This invention is especially designed as a water heating attachment for coal ranges provided with water backs arranged in the fire box One of the objects is to

provide a simple and inexpensive attachment which may be positioned in the fire box adjacent the water back to serve as a medium for heating when the coal range is not in use, the device may also be used for cooking purposes by shifting its position directly beneath the lids of the stove

RADIATOR.—A V KNOLL, 1525 College Ave Davenport, Iowa Among the objects is to provide a radiator having tubes which are of varying thicknesses along the width of the tube the cross section of the tube presenting a fluted or corrugated contour, whereby the expansion of the tube can occur as when the water freezes in the tube, without injury to the latter A further object is to provide lock seam joints, thereby preventing leaking

GAS REGULATING VALVE—L. E. TROSCLAIR, 5924 Magazine Street, New Orleans, La The invention relates generally to valves which are automatically operable by the pressure of one fluid to control the flow of another fluid, and more particularly to a valve which is operable by the pressure of steam within a boiler to control and regulate the supply of gas to burners used in heating the boiler

HEATER.—W R JONES Summitville, Ind The object of the invention is to provide a heater which will efficiently radiate the heat generated by the combustion of solid, liquid or gaseous fuel, which is easily controlled, and which is of simple and durable construction reliable in operation, and easy and inexpensive to manufacture. Features of the device are the air feeding and heat-distributing means arranged between the firebox and the casing

LIQUID FUEL FURNACE.—I PRIBBLE, 700 Topeka Ave, Topeka Kan The invention relates more particularly to coal oil burners of the type wherein air and steam vapor is mixed with the oil vapor, a purpose being to provide a burner which insures the proper and uniform mixing of the fluids to prevent the formation of carbon A further object is to provide a simple means for controlling the supply of the fluid to the burners.

Machines and Mechanical Devices

ATTACHMENT FOR PIPE MACHINES —L P HUFSMIDER, General Delivery, Tulsa, Okla The invention has for its object to provide an attachment adapted to be arranged between the dies and the chuck of a pipe machine for cutting the pipe at such point, wherein a ring is provided for attachment to the die frame, said ring having means for carrying a cutter and having means for adjusting the cutter toward and from the axis of the pipe

PICKER STICK -W F DAVITT c/o Messrs. Laggart, Tuttle, Wyman & Starr Merchants Bank Bldg Manchester N H The invention relates to a picker stick mechanism or motion for looms its object is to provide a device which eliminates all straps except the lug strap which operates in such a manner as to throw the shuttle straight across the loom and on the race board, which precludes all possibility of the picker stick jumping out of its holder with resulting damage to the cloth or shuttle or both, and which is simple and durable

TEARING MACHINE.—C H CLIFT, 54 Brookside Ave., Nyack N Y This invention refers to a machine for mechanically tearing material fed therethrough, and aims to provide means for stretching the material transversely to smooth it of wrinkles whereby it will accurately register with the tearing machine the device being adjustable to effect a tearing of the material into strips of various widths and lengths.

WASHING MACHINE.—J C AKER and M C WILLIAMS, 531 East 3rd St Duluth, Minn An object of the invention is to provide a manually operable device in which a pair of dashers are simultaneously reciprocated in opposite directions. A further object is to provide a machine which will be simple durable efficient in use, and comparatively inexpensive to manufacture

FILM DRYING NOZZLE.—R. C HUBBARD 203 West 140th St New York, N Y This invention relates to the drying of motion picture films, and has for its general object to provide nozzles adapted to deliver jets of air against the film with equal pressure at opposite sides, to dislodge water therefrom, by blowing the water from the film immediately before entering the dryer to complete the drying operation

SAFETY DEVICE FOR MOTION PICTURE MACHINE.—J E. WOODLAND 4842 Ashland Ave Richmond Hill L I, N Y The object of the invention is to provide a simple and compact apparatus which can be applied to any type of moving picture machine, and which operates a shield to cut off the light from the celluloid film whenever the film breaks or becomes disarranged, independent of the speed of the power mechanism operating the film The device can be readily reset upon the repair of the film.

SPINNING ROLL FOR SPINNING MILLS.—E. H WILSON and W C EHRENFELD, c/o Dural Rubber Co., Flemington, N J An object of the invention is the provision of means whereby rollers in spinning mills, especially those used for drawing the thread, can be very simply and easily repaired and replaced in the mill without requiring that they be sent back to the manufacturer The device comprises a removable sleeve which can be placed on and removed from the roll by any workman of average skill

STOP MOTION—H BERLIN, 57 W Houston Street, New York, N Y The invention relates more particularly to knitting machines. The primary object is to provide a mechanism in which if one of the threads of the machine breaks, the machine will automatically stop in order that the article made by the machine will be free of imperfections owing to a continuation of the knitting operation when one of the threads has been broken

SELF PROPELLING TRAVELING CRANE.—G BRUN, No 1 Rue Jules Lefebvre, Paris, France The invention has for its object to provide a crane capable of assuming all the positions that are required for the handling of loads, with a motor mounted on the platform of the crane and serving for lifting the load, also to drive the wheels of the platform and to turn the crane around its vertical axis, and the arrangement of the mechanism is such that the crane is capable of simultaneously lifting, swinging, and transporting the load.

SWELL CHECK FOR LOOMS—E. LAVALLEE, address A M. Surprenant, 200 Oak Hill Bldg, Pawtucket, R. I Among the objects of the invention is to provide a device for permitting the comparatively easy entrance of the shuttle into the shuttle box but for preventing rebound and to lock the shuttle in the box until the next stroke of the picker, wherein the pressure of the check is yieldable and wherein the extent of the breaking action may be varied

WELL MEASURING DEVICE.—R. C MASON, 1419 Quaker Street, Tulsa, Okla An important object of this invention is to provide a measuring device which may be conveniently mounted on the upper end of the well casing and engaged with the cable of the drill or the sand line for indicating to the attendant distance which the cable extends into the well

OIL CUP L C DUTRO 1235 Elm Ave, Long Beach, Calif The inventor has been granted two patents of a similar nature relating to oil cups having an automatic feed of oil controlled by the temperature of the bearing An object is to provide a device which will feed oil to cool the bearing as the bearing increases in temperature and which will automatically cease feeding as the temperature of the bearing falls. The cup being airtight the flow of oil will cease under normal conditions.

MACHINE FOR CUTTING BEVEL GEAR WHEELS WITH HELICAL OR STRAIGHT TEETH—V G DARTOIS 4 Boulevard Malesherbes, Paris, France. The machine invented by this patentee is capable of use for cutting either bevel gear wheels with helical teeth or bevel gear wheels with straight teeth, and is distinguished by a novel means for regulating and producing with precision the different motions of the cutting tool and overcomes defects in the operation of cutting the teeth of bevel gears by the usual methods.

SEWING MACHINE ATTACHMENT—O H GENTRY 790 Garson Ave Rochester, N Y This invention has for its object to provide a spring balance device that may be attached to any sewing machine and so adjusted as to assist the operator, and which eliminates the danger of running the machine backwards when the operator ceases to apply the driving force, and the machine will be brought to rest by springs, without making a revolution either backward or forward

TALKING MACHINE STOP—H E DAKIN, 81 High Holborn, London, W C., England. The invention relates to devices for automatically stopping a talking machine when the stylus reaches the end of the record The object is to facilitate the setting or adjustment of the automatic stopping device prior to each operation, so that the turntable will be arrested immediately the record has been played, irrespective of the length of the record.

DISTRIBUTOR FOR SOWING MACHINES.—C E. P JULIEN, 41 Boulevard Haussmann, Paris, France. The invention is particularly characterised by a distributing plate, having a frustro-conical aperture controlled by a frame sliding between two other fixed plates, in order to bring successively the aperture of the sliding plate in alinement with those of the fixed plates, and thus effect the distributing of seed, in quantity determined by the capacity of the aperture of the sliding plate.

DISHWASHING MACHINE.—H VAUDE VERE PUTMAN, 802 Campbell St., Schenectady, N Y An object of the invention is to provide a machine in which the dishes are constantly under water and wherein the cleaning is effected by creating a circulation of water so as to cause the latter to impinge upon the dishes at the most advantageous angle A further purpose is to provide a machine in which the parts are removable to facilitate cleaning.

COMBINATION CRUSHER AND MILL.—H. LOEVEN, 860 16th St., Douglas, Ariz. One of the principal objects is to provide a mill having means for crushing, milling, classifying and screening, either wet or dry, ore or rock in one continuous operation. The mill comprises a rotatable drum, a screen surrounding the drum, in spaced relation thereto, and means connected with the drum and adapted to be actuated by the movement of the material within the drum for vibrating the screen

PRINTING PRESS—LA QUINNO RHOADES, 621 Bush St., Freemont, Ohio. The invention relates in general to inking mechanism for printing presses, and more particularly to a track and adjusting mechanism especially adapted for use with printing presses of the platen type One of the principal objects is to provide tracks for the trucks or rolls of the inking rollers which are readily adjustable to compensate for wear or to adapt the inking mechanism to various sizes of forms.

PISTON FOR CONTROLLING FLUIDS UNDER PRESSURE.—A P LE BRON 38 Rue de Berri, Paris, France. The invention relates to a fluid tight movable partition or piston intended to separate two fluids under pressure without permitting these fluids to mix or lose in pressure. The result is obtained by interposed plastic packing between the members, the packing being engaged by portions of the piston members of less area than the area exposed to external pressure.

ROTARY PUMP—F N IMHOFF, J HUTCHINSON and C C HAMILTON address Jos. Hutchinson, Gull Lake, Saskatchewan, Canada This invention has for its object to provide a pump of the rotary type, comprising a rotor and a stator casing in which the rotor is mounted, the casing having inlet and discharge pipes for the fluid to be pumped While the device is a rotary pump it is also a motor working with equal efficiency in either direction, as a pump or as a motor

CLEANING DEVICE.—J DI PIAZZA, 213 E 107th St., New York, N Y The invention relates to a mechanical device particularly adapted to clean brushes. An object is the provision of an element of this nature in which all foreign matter will be effectively removed from the bristles of a brush The device is simple in construction and requires but little force to thoroughly clean the bristles of a hairbrush

AUTOMATIC STOP FOR TALKING MACHINES—A C ILIFFE, Haileybury, Ontario, Canada. A purpose of the invention is to provide an electrically controlled stopping apparatus which is adjustable to effect the automatic stopping of a talking machine when the stylus has reached the inner end of the sound groove of the record, irrespective of the diameter of the record. The apparatus may be operated manually should it be desired to temporarily dispense with the automatic feature.

Medical Devices

APPARATUS FOR DRYING AND MEDICATING AIR.—C DOSSE and A. E. PAINTER, address Albert E. Painter, Washoe County Bank Bldg., Reno, Nevada. This invention relates to an apparatus for dehydrating air and for adding to the same certain medicaments, disinfectants or the like. An object is to provide an apparatus wherein the air forced through said apparatus is treated to remove the moisture and other noxious ingredients, and to introduce certain curative and other beneficial and desirable properties for the treatment of diseases of the respiratory organs.

Musical Devices

PHONOGRAPH REPRODUCER.—W WHITTEN, 4 Grosvenor Square, Schenectady, N Y One of the objects of the invention is to provide a phonograph reproducer for reproducing the mechanically recorded sound with a minimum of movable parts. A further object is to provide a reproducer which may be used for reproducing the sound both from disc and cylinder records.

RECORD LIFTER.—J A. CLARK, 202 Main St., Vincennes, Ind. An important object of the invention is to provide a record lifter which is associated with the control of the phonograph whereby when the control is exercised to stop the rotation of the turntable the record lifter will be actuated to raise the record away from the turn-table and permit of the ready grasping and removal of the record.

SOUND POST—J W MCGRATH, Brookhaven, Miss. The aim of the invention is to provide a sound post for violins which will enhance the resonancy of the tone of the instrument in that the vibration of the base bar will be continued by means of the same for a much longer period. The device will serve to permit of more vibration being imparted to the essential parts of the instrument.

BANJO UKULELE.—R. A. CARLUCCI, 128 13th St., West New York, N Y. The object of this invention is to provide an instrument of the banjo-ukulele type arranged to give the desired tension to the skin or parchment head and to insure proper sounding when played, also to permit of conveniently replacing an injured skin by a new one.

RECORD DISK FOR GRAPHOPHONES AND METHOD OF FORMING SAME.—H PAKRMAN, 108 S Fourth St., Vineland, N J The invention relates generally to record disks for graphophones, the purpose being to provide a construction whereby much greater effectiveness in sound is produced The method consists of stamping a record disk as usual with a rim band around the sound groove, permitting the disk to harden, then cutting the rim away sufficiently to relieve pressure caused by its contraction during cooling

Prime Movers and Their Accessories

OIL LEVEL INDICATOR.—H. G MUELLER WEISS and B. E. BRAUN, c/o Thumb Accessory Co., Sebewaing, Mich Among the objects of the invention is to provide means whereby the oil level cock on an internal combustion engine may be readily opened from the dashboard of the vehicle, and to provide an attachment capable of being applied during the course of manufacture or at any time thereafter without altering the construction of the vehicle.

FLYWHEEL.—V W PAGE, 309 Lafayette Street, New York, N Y One of the primary objects of this invention is to so construct a fly wheel that the same may be made of relatively non-resistant and soft material, and, at the same time, provide means for keying the fly wheel to the crank shaft of an internal combustion motor with a member of greater strength than the fly wheel material

CONNECTING ROD GAUGE AND STRAIGHTENER.—F W NUSSWELL, 307 W 1st Street, Tulsa, Okla. The invention relates to gauges and straighteners especially adapted for use in connection with the connecting rods of internal combustion engines. An important object is to provide a gauge having means whereby it may be ascertained if the longitudinal axis of the wrist pin bearing or bushing is parallel to the longitudinal axis of the sectional bearing which receives the crank of the crank shaft, and whereby it may be readily ascertained if the rod is twisted or bent.

VALVE LIFTER GUIDE.—C. L. MAINLAND, 32 Hussen Ave., Hollis, L. I., N. Y The invention is especially designed for use in connection with the tapped valves of an internal combustion engine. A specific object is to provide in combination with the lifter guide of a valve, means which silences and prevents rattling, and means which automatically compensates for wear on both the reciprocating member and the guide, and to permit of replacement of repair when worn.

Miscellaneous Notes

The Largest Oil Pipe Line in the world, the only one to connect two oceans, will be laid by the Mexican government across the Isthmus of Tehauntepec.

The New York Curb Market, the second largest stock market in America, has deserted the curb and now transacts its business under a roof. It has just brought out an illustrated book descriptive of its functions, membership, and operations.

Servants Introduce New Problems.—In advertising for positions servants are now specifying the particular make of washing machine and vacuum cleaner they must have. Is the electrically-equipped kitchen to prove more of a boomerang than a blessing?

The Problem of the Spaniard's Foot.—Tradition has it that the first Spaniards to land on Hawaii were wrecked on the southeast coast in 1575; but the clear imprint of a Spanish shoe has been discovered in the surface of an ancient lava flow on the west coast near Honaunau, the "City of Refuge." Since the lava flow must antedate the building of the city in 1100, how the footprint got there is a mystery that will probably never be solved.

John Bull Loses.—A British Houdini offered $250 to the producer of any strait jacket from which he could not release himself. A certain John Bull invented a jacket and took up the challenge, but the performer, after successfully freeing himself, cut up the jacket and distributed pieces to the audience. Bull sued for $50 damages, the court, however, held that in a test of this kind the plaintiff must risk a damaged jacket, so John lost not only the jacket but the suit.

Legal Help in Foreign Trade.—The Division of Commercial Law of the Department of Commerce is compiling names of well recommended foreign attorneys who are in a position to care properly for American interests. These names will not be published, but American firms in need of an attorney in any particular foreign locality may apply for and receive the necessary information. No responsibility is assumed either by the Bureau or by the sponsors for these attorneys.

Civics Without Textbooks.—Our larger cities have lately instituted a departure in the teaching of civics in elementary schools, textbooks are discarded and the outcome of several months' test is most encouraging. New York has instructed the children in 21 subjects, from the food of the city and the dispensation of public charities to the part of the citizen in government and the management of the schools. First hand demonstrations have been given of the work of the fire department, and the "project method" sets the children to cleaning up and beautifying the school grounds. The benefits have already extended to entire communities.

Newsprint and Pulpwood.—It takes 40 years to grow pulpwood spruce, and our newspapers are using 3,000,000 cords of wood a year. The American Forestry Association suggests a plan by which 30,000 square miles of our cut-over lands, now unproductive, might be planted to 40 successive crops of timber; this would mean a perpetual supply of newsprint. With sound national forestry laws, the cooperation of the States, and active participation by the pulp and paper interests, our staggering fire loss would be held within reasonable limits, and the needful supply assured. Our yearly 2,000,000 tons of newsprint, in a ribbon the width of the daily paper, would extend 40,000,000 miles into space; only broad visioning and prompt action can save this gigantic industry from further disaster

Advertising in the Far East.—The Japanese are irresistibly drawn to the artistic, and they are above all desirous of being thought alert and progressive. These apparently unrelated traits have influenced the trend of our advertising in Japan with beneficial results. The beautiful portrayal of a product by pictures touches the Japanese artistic sense, while continued repetition establishes the desirability of the product in the mind. In an appeal to Canadian manufacturers to "go and do likewise," the Trade Commissioner at Yokohama admits that United States' manufacturers understand advertising psychology better than almost any other country in the world, and pays high tribute to our success in Japan. By [illegible] high standards we [illegible] that results will [illegible].

NEW STARRETT TOOLS

New Starrett Beveled Edge Squares The line contact made by the beveled edge of these squares in contact with the work on which they are used is a feature that The L. S Starrett Company believes will be much appreciated by many mechanics. With the exception of having beveled edges on both sides of the blades these No. 55 squares are similar to the well-known Starrett No. 20 Solid Steel Squares.

A further recent addition to the Starrett line of squares is the new *No. 140 Double Steel Square.* This square has a 4-inch sliding block graduated to 32nds and 64ths on one side and 8ths and 16ths on the other. Similar to the No 14 Starrett Square but has larger beam

Starrett T-Handle Tap Wrench The handy tool for general use Recommended for general use by tool makers, machinists and other mechanics Especially designed for holding taps to be turned by hand, but can be used to equal advantage for holding drills, reamers, and other small tools. Jaws are designed to retain firm hold on tools and are heat-treated, insuring durability.

Another Starrett Vernier Height Gage is the new No. 454. 18-inch size with heavy base. Made in three types respectively graduated in English Measure, Metric Measure and both English and Metric Measures.

Starrett Protractor and Depth Gage No 493 6-inch sliding scale on protractor is graduated to 64ths and may be adjusted to gage any depth within capacity, it also may be swung on the protractor, enabling the user to conveniently lay off any angle within 180° The L S Starrett Company believes this tool will become especially popular with draftsmen, machinists and shop foremen because of the convenience its use affords in laying out work.

At Last!—A Real Bench Block At last mechanics are provided in the Starrett No 129 Bench Block with a really suitable tool for facilitating the work of driving pins in round or flat work. The blade is a 3-inch disk, 1½ inches high, and has 9 holes varying from ⅛th inch to ⅝ths inch in size, also a V groove for holding round work.

Miscellaneous Notes

Negro Farmers.—There were 926,257 negro farmers in the United States January 1, 1920, according to the Bureau of the Census. In 1910 the number was 893,370.

Vesuvius Wakes Up.—The volcano celebrated last summer by displays of enormous smoke clouds. The demonstration is not thought to presage any serious eruption

The Bones of Dante.—At the close of the Dante celebrations at Ravenna, fragments of the bones of the poet, stolen in 1865 but later recovered, were reunited to the skeleton.

Rescue Party Fails.—The party sent to find Knudsen and Tessen, who became separated from their comrades in the last Amundsen polar expedition, returned only to report failure.

Back to the Days of Barter.—A typewriter manufacturing company of Hartford, Conn., has sold a consignment of typewriters to the Russian Government, receiving payment in the form of sealskins and sables.

Automobile Aid for Mothers.—Ten towns near Cleveland, Ohio, had the benefit this summer of a baby clinic on wheels. A completely fitted truck in charge of physicians and trained nurses furnished this free service.

Flowers in a Block of Ice.—A wreath of Australian flowers, placed on the Cenotaph in Whitehall, London, by the Australian prime minister, made the long journey in a block of ice, and were quite fresh for the ceremony

Human Hair as a Commodity.—Forty bales of human hair is one item of a cargo reaching Seattle from China. Each 133-pound bale is worth more than $400 here, our annual imports exceed $500,000, and most of the hair goes into hair nets.

National Parks and the Automobile.—Motor cars carried 600,000 persons through the Denver mountain park system in 1921. Motor visitors to Rocky Mountain National Park numbered 273,737, or 100,000 more than those attracted to the Yellowstone and Yosemite Parks put together

Motor Fuel from Weeds.—Prof. Mailhe Toulouse believes that thousands of common weeds can be made to yield petrol containing large percentages of benzine and toluene. His process also produces a gas said to have developed 20,000 heat calories, which alone would pay for the necessary plant installation.

Heat Waves and Crime.—Apropos of the combined heat and crime wave in Paris, French psychologists are reviving the old theory that high temperature and crime go hand in hand They instance the violence and cruelty of the Spaniard, ignoring facts that do not fit their theory Why not look upon the tyrants and torturers of Siberia as natural products of the frigid air?

The Motorboat Garage.—Taking a hint from the automobile garage, floating garages for motor boats now sport sundry "free" signs, among them "Free electric bilge pump," "Free docking and rest rooms" and "Free use of hoist for residents." To Sheepshead Bay, Brooklyn, goes the credit for initiating these free services, which will doubtless prove not only popular but remunerative.

The Rubber Sponge and the High Flier.—The rubber sponge, now so commonly used in the bath, has been successfully adapted to other uses, it fills life preservers in place of the elusive air, and it provides soundproof telephone booths. Aviators are now defying the cold of high altitudes with rubber garments, among them a vest made from sponge rubber Anyone who has worn a rubber coat on a warm day can testify that it retains the heat of the body while preventing any cool air from reaching it, and sponge rubber, with its air-filled interstices, combines warmth with lightness.

The Alps Yield Up the Dead.—The glaciers and snow fields melted so much during the long hot summer of 1921 that many long-lost bodies were found. One was that of a guide lost 18 years ago; another, a Swiss school teacher who disappeared in 1914; and inasmuch as the winter just past has been mild, it seems that many more bodies will be recovered this summer It is hoped that the remains of Lord Frederick Douglas, killed during Whymper's ascent of the Matterhorn in 1865, may be found. Ice surpasses embalming, and if we could get to the bottom of the Arctic ice we might learn what men were like 50,000 years ago.

Electrical Notes

More Light with Less Current.—The old subject of keeping electric lamps and reflectors clean is again brought to our attention by Ward Harrison and J. R. Colville, in a recent issue of *Electrical Review and Industrial Engineer* Among the items discussed by these authorities are the extent and causes of lighting depreciation, value of light wasted, and systematic maintenance. Experience has shown that in many factories more than 30 per cent of the light paid for is allowed to go to waste. One-half to two-thirds is being thrown away through lack of attention to simple maintenance requirements. In a plant where the entire time of one man is required the cost of cleaning open reflectors should not exceed 3 cents each

Searchlight Carbons.—There is a whole field of scientific knowledge and room for experimentation in the matter of searchlight carbons. In an arc light the desire is, of course, for the highest possible brilliancy, and this brilliancy is obtained by light which emanates from incandescent particles, and since incandescence is a function of temperature, it is therefore necessary to use a material which will give the light source of maximum brightness. Since carbon has the highest melting point of all the common substances, it was natural to use this material for electrodes, especially since it has the advantage of leaving little residue unconsumed. The temperature of the crater of the positive electrode in the pure carbon arc is about 3700 degrees and gives a brilliancy of about 160 candlepower per square millimeter, continues *The Sperryscope.*

What Is the Power of Lightning?—Various estimates of the electrical power of lightning have been made from time to time, and we now add to our published collection the opinion of E. Poirson, as expressed in a recent issue of *Revue Generale de l'Electricite.* A cloud with a radius of 500 meters, states this French authority, situated 400 meters above the ground, represents a capacity of 0.055 mfd. The earth capacity is assumed to be 700 mfd. A bolt from this cloud to ground may have a potential of 50,000,000 volts. Assuming an air resistance of 10 ohms and the self-inductance of the rectilinear distance of 400 meters to be about 0 00075 henry, the frequency of such a discharge would be 24,700 cycles a second. A total of about 60,000,000 joules would be liberated in such a bolt, and, assuming a thousandth of a second as the time of discharge, this would equal 60,000,000 kilowatts.

A Novel Electrolytic Meter.—Much difficulty was experienced in Austria during and shortly after the war in obtaining a sufficient number of electric meters for new customers, according to *Zeitschrift fur Elektrotechnik and Maschinenbau.* A very simple and accurate meter was developed on the principle of the electrolytic meter An iodine-mercury electrolyte is used between a mercury anode and a carbon cathode, both sealed into a glass vessel with an accurately calibrated measuring tube The volume of this tube is so chosen as to be sufficient for one or two years, after which period the tube is reversed and emptied. The voltage drop of the meter is about one volt. Of course, the instrument is only an ampere-hour meter, but experience has shown that variations of the voltage settle quickly to the normal value and that, therefore, the absence of a voltage coil is not a serious drawback.

Steel-Aluminum Conductors.—In a recent issue of *Electrical World* it is shown that properly dimensioned steel aluminum conductors—that is, stranded steel cable surrounded by one or more layers of aluminum wires—are mechanically superior and electrically equal to copper conductors, a fact which was recognized some time ago in America but was doubted in Germany. It is essential to use very pure aluminum, not less than 90 per cent, as otherwise heavy oxidizing will take place. The strength of the aluminum cable should be at least 85 or 90 per cent of the strength of the individual strands. The chief objections raised against a composition steel and aluminum cable were the electrolytic action between the two metals and the difference in the expansion coefficients. Practical experience showed that both objections were unfounded. Bessemer steel wires having a tensile strength of 120 kilograms per square millimeter are recommended for the steel core, and a double layer of aluminum wires should be used. The ratio of steel to aluminum should be for very important trunk lines 1 to 4, for secondary lines 1 to 6.

Electrical Notes

Electrically-Operated Silver Reclaiming Plants.—Owing to the high cost of chemicals in general and acids in particular throughout Europe, it has been found cheaper to reclaim silver out of the dust of mints, jewelers refuse, and so on by the electrolytic process rather than by purely chemical methods. Using nitrate of silver as an electrolyte, a potential of one volt per cell and a current density of 250 amperes per square meter will give best results. Four cells are used in series, each containing six cathodes and fifteen anodes To prevent the growth of silver deposit from the negative plates on the anodes, which would short-circuit the cell the cathodes are enclosed in muslin bags and are, in addition moved slowly backward and forward during the process.

Specifications for Lamps.—New specifications for large incandescent electric lamps have been issued by the Bureau of Standards. There have been some changes, an important one being the abandonment of the long-established provision that the light test of lamps shall be considered as ended when the candlepower has fallen to 80 per cent of the initial value Because means have been found to prevent excessive blackening of tungsten lamp bulbs, the new tests are based on the total life of the time of burn out The standardization of lamps is on a smaller number of gradings, the tungsten schedule recognizing only the 5 volt steps in the 110-120 range, and the 10 volt steps in the 220 250-volt range The publication of these specifications is now ready and may be obtained from the Bureau of Standards Washington D C.

Safety Rule for Electric Welding.—Some simple rules are given in a recent issue of *Electrical World* with regard to electric welding as follows 1 Goggles —When more than one person is working in a booth each must wear amber or blue goggles to protect his eyes from accidental flashes from adjacent arcs when his hood is off 2 Hood —Always wear a hood or use a shield with amber or blue glass window for protection of the eyes and face against harmful ultra violet and infra red rays from the arc 3 Clothing —For protecting against burns from incandescent particles expelled from the arc closely woven clothing gauntlets and leather shoes having bellows tongues should be worn 4 Cable —Always have cable above the ground so that it will not be stepped on On scaffold or platform work run the cable under the platform so that it will not be tripped over 5 Ground —Be sure the material to be welded is properly grounded before starting to weld 6.—Scaffold Work.—When working on a scaffold be sure that hot electrode stubs or drops of hot metal will not fall on persons below the scaffold 7 Footing —Be sure you have a substantial footing before starting the weld 8 Ventilation —There must always be sufficient ventilation in the booth to keep it clear of fumes 9 Welding Booths —Welding must be done in a booth inclosed on three sides to prevent injury to persons working in the vicinity

Supersensitive Electrical Instruments.—At the Annual Exhibition of the Physical Society of London a number of interesting electrical instruments were shown not the least interesting being a string electrometer As is well known the string electrometer originally suggested by Professor Einthoven is an instrument in which the moving system is a silvered quartz fiber tightly stretched between and parallel to fixed metal plates The special feature of a recent model is its compactness and the ease with which it can be assembled with any other apparatus. In particular being flat, this model may be used on a microscope stage without further fittings. The instrument consists of a silvered quartz fiber each end of which is carried by a flag which is anchored to an amber block by means of a brass clip. One flag is held in a slot in each clip by a screw This enables the interchange of fibers to be done simply as fibers can be supplied ready mounted on flags, and can be transferred by means of a fiber manipulator The ends of the fiber are mounted on an invar steel rod so that variations of temperature have only a small effect on the tension of the quartz fiber Observation of the fiber is made through a microscope, with a finely adjustable forward and lateral movement. The instrument is extremely rapid in action, the free period being small. If desired, it can be employed as an oscillograph electrometer It is sensitive, with a very small capacity, and the sensitiveness can be steadily varied.

Mechanical Engineering Notes

Hexagon Nuts.—A new machine for producing these with a mere 10 per cent waste, in place of the 50-60 per cent heretofore lost, is announced This result is achieved by the use of indenters which indent the bar between each pair of nuts to be thus eliminating side scrap

Submerged Drilling.—One way to apply the coolant in drilling is by spray drip or analogous methods Another is to have the entire operation conducted while tool and work are submerged in the fluid There are specific advantages here higher efficiency and less grinding chips are kept from sticking to the drill and stock by the continuous circulation of the lubricant etc In many cases it seems as though this idea would be worthy of a trial

Improving the Lubrication. — We watched a garage mechanic the other day drill a hole of one-eighth or three-sixteenths inch diameter through the hub of each connecting rod clear through from outside to inside in order to improve upon the results of splash circulation of oil and make sure that the actual bearing surface between the rod and the crank shaft throw should get its fair share of oil It seems as though a judicious application of this remedy for faulty lubrication—always with due consideration whether it would lead to structural weakness of the part in question—might be profitable in ordinary machine practice

Machines for Blind Operators.—German practice in breaking in blinded soldiers on machine and tool work has emphasized the fact that the blind operator is in considerably more danger of inadvertently engaging his free hand with the machine than the seeing worker The difficulty has been met in ingenious fashion—by robbing him of the free hand Machines for operation by the blind men are now designed especially for this purpose and in such a fashion that the operator is forced to exercise a two handed control Both his hands are continually on the handles and levers—and he is therefore in no danger of getting one of them in the path of a tool

Care of Punches.—The breakage of punches is not infrequently caused by their being adjusted so that the finer ones projecting further than the heavier ones make contact with the metal first. The setter who is often made responsible for the adjustment of punches should be sure and see that the heavier ones project further than the finer ones in order that by entering the metal first they may take the brunt of the shock Distortion of punches is liable to occur when particles of dirt or small cuttings are allowed to get in among the pieces to be punched Such foreign matter prevents the metal from lying flat on the [illegible] resulting in the punches descending on an inclined instead of perpendicular face Punches require grinding when stampings begin to show rough or jagged edges Sometimes the same fault is due to bad setting of the tools the punch gradually shearing away the die until it becomes a loose fit and thereby fails to produce good stampings —*Practical Engineer*

Chain Driven Machine Tools.—The chain drive so largely used in the automobile world possesses advantages over the belt drive which engineers are bound to admit says H Bentley in *Engineering and Industrial Management* It is positive —that is there is no slip A belt must be continually attended to to keep a high efficiency The correct range and graduation of speeds is obtained (not 2 or 3 per cent of slip) so that the maximum output is possible. Shafts may be driven at short centers more effectively by chain than by belting Sometimes a crossed belt is employed to get a larger angle of lap and to surmount the short-center difficulty but this requires constant attention and is not so efficient as the chain Frequently a motor is mounted on a foundation plate on the floor in order to obtain sufficient length of belt drive to the line shaft where if a chain is used the motor may be carried on brackets close to the line shaft and the floor space saved On account of the strength of the chain drive it is possible to get the whole arrangement in very little space As no initial tension is required with a chain the chain can run slacker than a belt, and journal friction is reduced to a minimum The flexibility and silence when running are other useful features. It is possible to run at very high speed when the chain is enclosed in an oil bath.

Patent and Trade-Mark Notes

Apparatus and Method Claims.—In ex parte Sweetland (297 O G, 397) the Commissioner of Patents has made the following rulings Where a patent with apparatus claims drawn in generic terms has been granted method claims which are substantially co-extensive with the apparatus claims of the patent should not be allowed to the same party in an application filed subsequently to the issue of the patent. If the steps of the method are such that the apparatus or its equivalent recited in claims of the patent must be present in order to carry out the alleged method the latter is but the *function of the apparatus*

Trademarks in Uruguay—According to the trademark law of Uruguay the registration of a trademark creates proprietorship in and constitutes the title deed of a given mark but without prejudice to the above persons who may have in the country a trademark in use which is not registered or the registration of which has lapsed, may challenge the registration of the same mark by a third party If the third party has effected the registration and obtained legal protection the other party may apply to the Government to have the registration detrimental to his previous right of use annulled This may be done within two years from the date of the inscription challenged While trademark piracy is not so common as in those countries where registration constitutes undisputable ownership it is recommended that application for registration be made before shipping branded articles to Uruguay

Commercial Success as Indicative of Invention—While it is true that marked commercial success and public approbation of a patented invention are sometimes of importance in determining the question of invention the doctrine involved is subject to exceptions The United States Circuit Court of Appeals for the Second Circuit, in a recent decision (Boston Pencil Pointer Company vs Automatic Pencil Sharpener Company 276 F 910) distinctly points out such an exception The Court said in effect first that commercial success is an unsafe guide to invention unless prior efforts to fill the want are shown and secondly that articles may be new in a commercial sense when they are not new in the sense of the patent law and novelty however great can never be put in place of invention The fact that a patented device has had enormous sales does not dispense with all other evidence of invention

Substitution.—A manufacturer or dealer cannot substitute the merchandise of one where the merchandise of another is ordered without informing the purchaser of that fact In Samuel Brothers & Co vs Hostetter & Co 118 F 258 it was held sufficient to support a finding that the defendant was engaged in unfair competition although there was no proof of any customer having actually been deceived on the testimony of two witnesses employed by the complainant These witnesses testified that they had gone to the wholesale liquor store of the defendant, where there had been sold to them by a clerk what was represented to them to be complainant s bitters, but which in fact, was a spurious article made to imitate that of complainant s in appearance taste and smell and they were also furnished by the clerk with empty bottles having thereon complainant s label and trademark to be used in retailing the bitters to customers.

United Shoe Machinery Corporation Patent Leases—The Supreme Court of the United States on April 17 1922 rendered its decision in reviewing a Decree of the Federal Court of the Eastern District of Missouri involving the leases of the United Shoe Machinery Corporation under the terms of which that company leased its patented machines to users thereof The Decree of the Missouri Court was sustained by the Supreme Court. This Decree enjoined the use first, of the restrictive clause which provided that the leased machine should not be used in the manufacture of shoes on which certain operations had been carried out by machines other than those provided by the corporation secondly the clause that if the lessee failed to use certain kinds of machinery made by the corporation the latter had the right to cancel the lease of all machines thirdly the clause which compelled the lessee to purchase all supplies from the corporation fourthly, the clause which compelled the lessee to use the corporation s machines on shoes worked on by other machines of the corporation, fifthly, that if the lessee failed to lease all additional

LEGAL NOTICES

Annual Subscription Rate

Scientific American (established 1845) one year	$4 00
Postage prepaid in United States and possessions Mexico Cuba and Panama	
Foreign Postage	$1 00 per year additional
Canadian Postage	$0 50 per year additional

Remit by postal or express money order bank draft or check.

machinery from the corporation the latter would have the right to remove the machines already employed sixthly the provision for a payment of royalty on shoes made on the corporation machines and seventhly, a preferential clause which specified lower royalties for lessees who agreed not to use certain machinery on shoes lasted on machines that were not corporation equipment.

Brazilian Trade Mark Registrations.—Although the United States is not a member of the Berne Trade Mark Convention nevertheless our exporters will be interested in the recent decision handed down by the Supreme Court of Brazil in which it was held that international registrations at Berne are not effective in Brazil While Brazil is a member of the Berne Trade Mark Convention it has been held that the failure to publish the trade mark in Brazil is fatal This requirement with reference to publication applies to all trade-marks and all classes of registrations whether an independent Brazilian application is filed or whether an attempt is made to protect a trade mark through a Berne Convention registration or a registration under the Pan American Convention No arrangements have been made for the publication of trade mark applications except in cases where independent Brazilian applications are filed and in view of the ruling which has been made and other rulings which may follow it is important that every trade mark which is of value in the Brazilian market be protected by an independent registration in that country

Corporate Names.—It is well settled that one corporation cannot adopt and use the name of another corporation in the same line of business. Furthermore a corporation cannot use as part of its corporate title the trademark or trade name of another earlier in the field nor can anyone use as a trade mark for the same line of business the title or part thereof of a corporation or firm In Rubber & Celluloid Harness & Trimming Company vs The Rubberbound Brush Company 88 A 210 it was held that the use of the words Rubber Bound in defendant's corporate name was in contravention of plaintiff's rights in the term Rubber Set as applied to its merchandise In Martell vs St Francis Hotel Company 98 P 1116 it was held that the defendant would be enjoined from conducting its hotel under the same name as that of plaintiffs in the same neighborhood and previously established such use resulting in confusion and injury to the hotels and the public and this though defendant's hotel was larger and more expensive and catered more to a transient trade, while that of plaintiffs though patronizing transients, was more of a family hotel

The Stanley Bill.—The Stanley Bill, which has been introduced in the Senate and which contemplates the making of a very drastic change in our existing patent law has aroused a great deal of interest and much argument pro and con Briefly the effect of the Bill is to include in our patent law a provision whereby unless within a reasonable time a patent is worked compulsory licenses thereunder may be granted The law is advocated by the War Department, on military grounds and in order to compel foreign nations and inventors to manufacture their inventions in this country so that in case of war they would be at the service of this country The Bill is also favored by certain manufacturers. In the main however opposition to the Bill is strong The Executive Committee of the American Patent Law Association has taken a very definite stand in opposition saying It strikes at the very heart of our patent system in that it would destroy the exclusive right of the patentee to his invention This is the distinguishing feature of the patent law of this country that makes it superior to the law of any other country For this reason it would be equally bad for the public the inventor and the manufacturer

Taxi Cabs of Distinctive Color.—Justice Newburger of the Supreme Court of the State of New York in recently granting a temporary injunction in favor of the American Yellow Taxi Operators Inc. restrained the defendant from using or employing or operating for hire taxi cabs designed or painted or colored in imitation or colorable simulation of plaintiff's taxi cabs" And also adopting using or employing on taxi cabs any names, devices, finish, color or get up style or dress calculated to be confused with or mistaken for taxi cabs of the plaintiff I know of no clearer case of attempting to mislead the public as the defendant admits he has done," said Justice Newburger

LIMITED COMMERCIAL (BROADCASTING) STATIONS

So numerous have been the inquiries received with regard to a list of radio-phone broadcasting stations that we have decided to publish a complete list of such stations, up to and including April 20th. As new stations are opened up for radio-phone broadcasting service, we shall endeavor to make mention of them in our future issues, thus keeping this list up to date.—The Editor

Call	Station	[illegible]	[illegible]	[illegible]
WBY	Alabama Power Co., Brown-Marx Bldgs. Birmingham, Ala	X	—	—
KHD	Aldrich Marble & Granite Co., The C. F 1704 Tejon St. N Colorado Springs Col.	—	—	X
KZM	Allen Preston D 13th and Harrison, Oakland, Calif	X	—	—
KGO	Altadena Radio Laboratory 2490 Maiden Lane Altadena, Calif	X	—	—
WGI	American Radio & Research Co. Medford Hillside Mass	X	—	—
KFI	Anthony, Earl C Inc 10th and Hope Sts. Los Angeles, Calif	X	—	—
WMA	Arrow Radio Laboratories 1127 Arrow Ave Anderson, Ind	X	—	—
KYY	Atlantic-Pacific Radio Supply Co., 8063 Ocean View Drive, Oakland, Calif	X	—	—
WMB	Auburn Electrical Co. 87 Court St Auburn Me	X	—	—
WOR	Bamberger, L., & Co., 131 Market St. Newark, N J	X	—	
KNR	Beacon Light Co The 696 South Hill St Los Angeles, Calif	X	—	—
WEB	Benwood Co Inc The 1110 Olive St. St Louis Mo	X	—	—
KJS	Bible Institute of Los Angeles, Inc 536 S Hope St. Los Angeles Calif	X	—	—
KXS	Braun Corp The 363 New High St. Los Angeles Calif	X	—	—
WOE	Buckeye Radio Service Co The 569 S. Main St Akron O	X	—	—
WDZ	Bush James L Star Store Bldg Tuscola, Ill	X	—	—
WPE	Central Radio Co. Inc 573 Grand Ave Kansas City Mo	X	—	—
WDM	Church of the Covenant, 18th and N Sts., N W Washington D C	X	—	—
WBU	City of Chicago LaSalle and Washington St. Chicago Ill	X	—	—
WRR	City of Dallas Police and Fire Signal Dept Dallas Texas	X	—	X
WCN	Clark University Worcester Mass	X	—	X
WMC	Columbia Radio Co South Ave at Indianola Youngstown O	X	—	—
WAAH	Commonwealth Electric Co Inc 182 184 E. 6th St. St Paul Minn	X		
WIL	Continental Electric Supply Co 906 9th St N W Washington D C	X	—	
KZI	Cooper Irving S 2041 Argyle Ave Los Angeles Calif	X	—	—
WEY	Cosradio Co The, 1725 Fairmount Ave, Wichita Kan	X	—	X
WHK	Cox, Warren R 1985 E. 66th St. Cleveland O	X	—	
WIW	Crosley Mfg Co 3820 Colerain Ave Cincinnati O	X	—	—
WWB	Daily News Printing Co The 402 3d St N W Canton O	X	—	—
WJX	DeForest Radio Telephone & Telegraph Co., 1391 Sedgwick Ave New York City	X	—	—
WWJ	Detroit News The, 615 Lafayette St Detroit Mich	X	X	X
KOP	Detroit Police Dept. Bethune and John R Detroit, Mich	Police information		
KFZ	Doerr-Mitchell Electric Co 118 Lincoln St Spokane Wash	X	—	—
WRK	Doron Bros. Electric Co, 839 No C Hamilton O	X		—
KQV	Doubleday Hill Electric Co 719 Liberty Ave Pittsburgh Pa	X	—	—
WMU	Doubleday Hill Electric Co Hall, Frank M, 415 Randolph St, N W Washington D. C	X	—	—
WHU	Dork The Wm B Co, 324 Superior St, Toledo O	X	—	—
KLB	Dunn J J & Co. 1295 E. Villa Pasadena Calif	X	—	
WAAJ	Eastern Radio Institute, 899 Boylston St. Boston Mass	X	—	—
WJT	Electric Equipment Co. 703 State St. Erie Pa	X	—	—
KGC	Electric Lighting Supply Co 5118½ Harold Way Hollywood Calif	X	—	—
KQT	Electric Power & Appliance Co Inc, 17 No. 3d St., Yakima Wash.	X	—	—
WPI	Electric Supply Co., 128 Market St Clearfield, Pa	X	—	—
KSL	Emporium The, Market St. San Francisco, Calif	X	—	—
WSX	Erie Radio Co., 117 W 9th St. Erie, Pa	X	—	—
KUO	Examiner Printing Co. The, San Francisco, Calif	X	—	—
WPR	Federal Institute of Radio Telegraphy 3d and Federal Sts., Camden, N J	X	—	—
WGR	Federal Telephone & Telegraph Co., 1738 Elmwood Ave. Buffalo, N Y	X	X	X
WPL	Fergus Electric Co. 334 Main St., Zanesville O	X	—	—

Call	Station	Entertainment	Market	Weather
WCE	Findley Electric Co Inc 212-216 So. 5th St Minneapolis Minn	X		—
WPA	Fort Worth Record Fort Worth Texas	X	X	X
WWI	Ford Motor Co Michigan Ave Dearborn Mich	X		
KFV	Foster-Bradbury Radio Store Herald Block Yakima Wash	X		
WGY	General Electric Co 1 River Road St Schenectady N Y	X	—	
WCJ	Gilbert The A C Co 493 Blatchley Ave New Haven Conn	X		
WIP	Gimbel Bros Dept Store Market St at 9th. Philadelphia Pa	X		
KJQ	Gould C O 615 E Main St Stockton, Calif	X		
KGG	Hallock & Watson Radio Service, 192 Park St Portland Ore	X		
WLK	Hamilton Mfg Co 2011 Alabama North Indianapolis, Ind	X		X
WOH	Hatfield Electric Co 531 N Meridian St. Indianapolis Ind	X		
KYG	Hawley Willard P Jr 400 E 32d St. North Portland Ore	X		
KQW	Herrold Charles D 467 1st St San Jose Calif	X		
KVQ	Hobrest J C 915 7th St Sacramento, Calif	X		—
KON	Holzwasser Inc 5th and Broadway Los Angeles Calif	X	—	—
WJD	Howe, Richard Harris, Granville O	X		
WGL	Howlett, Thomas F J 2308 N Broad St Philadelphia Pa	X		
WSV	Hunter Dr L M and Carrington G L 2420 Izard St Little Rock Ark	X	—	—
WEV	Hurlburt Still Electrical Co McKinney Ave and San Jacinto St Houston Texas.	X		X
WGV	Interstate Electric Co and New Orleans Item 257 Barrone St. New Orleans La	X	—	
WIK	K & L Electric Co 427 Olive St McKeesport, Pa	X	—	
WTG	Kansas State Agriculture College Manhattan Kan	—	—	X
WOC	Karlowa Radio Co 606 Best Bldg Rock Island Ill	X	—	X
KLP	Kennedy Colin B Co Inc O Keefe Ave Los Altos Calif	X		
KHJ	Kierulff C R & Co 757 S Los Angeles St Los Angeles Calif	X		
KQL	Kluge Arno A 1045 S Bixel St Los Angeles Calif	X	—	
KJR	Kraft Vincent I 6838 19th Ave N E Seattle, Wash	X	—	
KMC	Lindsay Weatherill & Co Reedley Calif	X	—	
KGB	Lorden Edwin L 602 California St San Francisco Calif	X	—	
KMO	Love Electric Co (H C Reichert), 918 North L St Tacoma Wash	X		
WWL	Loyola University 6363 St Charles Ave New Orleans La	X		—
WDZ	Marshall Gerkin Co 27 Ontario St Toledo O	X	X	X
KRE	Maxwell Electric Co Claremont Hotel Berkeley Calif	X	—	
WBS	May D W Inc 178 Central Ave Newark, N J	X	—	
WTP	McBride, George M 611 Midland St Bay City Mich	X	—	
WWT	McCarthy Bros & Ford 75 W Mohawk St Buffalo N Y	X	—	
WOU	Metropolitan Utilities District 1802 and 3405 Farnum St Omaha Neb	X	X	
KYJ	Meyberg Leo J, Co 8th and Broadway Los Angeles Calif	X	—	X
KDN	Meyberg Leo J Co Fairmont Hotel San Francisco Calif	X	—	X
WAH	Midland Refining Co 80 S Main St El Dorado Kan		X	X
WEH	Midland Refining Co Tulsa Okla	—	X	X
WOS	Missouri State Marketing Bureau, Capitol Bldg Jefferson City Mo	—	X	—
WGH	Montgomery Light & Water Power Co Montgomery Ala	X		X
KGU	Mulrony Marion A Waikiki Beach Honolulu Hawaii	X		—
WAAM	Nelson Co I R Bond St Newark N J	X	—	—
KOB	New Mexico College of Agri and Mech Arts State College New Mexico	X		X
WPB	Newspaper Printing Co. Gazette Sq Pittsburgh Pa	X	—	—
KLN	Noggle Electric Works, Alvarado St, Monterey Calif	X	—	
KFC	Northern Radio & Electric Co 418 Union St. Seattle Wash	X	—	—
KGN	Northwestern Radio Mfg Co 1556 E Taylor St Portland, Ore	X	—	—
WAAL	Minnesota Tribune Co 54 S 4th St Minneapolis Minn	X	—	—
WPG	Nushawg Poultry Farm R D No. 2 New Lebanon O	X	—	—
WSL	O Connor, Leon James, 24 Bank Pl, Utica N Y	X	—	—
WKY	Oklahoma Radio Shop 1911 W Ash St. Oklahoma City Okla.	X	—	X
KGW	Oregonian Publishing Co., 6th and Alder Portland Ore	X	—	—
WOZ	Palladium Printing Co., Richmond, Ind.	X	X	X
WTK	Paris Radio Electric Co 42 S Main St, Paris Texas	X		
WOK	Pine Bluff Co The Pine Bluff Ark	X		
KGF	Pomona Fixture & Wiring Co 810 W 2d St Pomona Calif	X		
KWG	Portable Wireless Telephone Co 530 E Market St Stockton Calif	X		
WMH	Precision Equipment Co 2437 Gilbert Ave Cincinnati O	X		X
KFU	Precision Shop The Sycamore St Gridley Calif	X		
KSS	Prest & Dean Radio Research Laboratory 18 Elm Ave Long Beach Calif	X		
KSD	Pulitzer Pub Co. (The Post Dispatch) 12th and Olive Sts St Louis Mo	X		
WBAA	Purdue University West Lafayette Ind	X		
WDW	Radio Construction & Electric Co 542 Irving St Washington D C	X		
WDY	Radio Corp of America Roselle Park, N J	X		
WAAO	Radio Service Co 1019 Quarrier St Charleston W Va	X		
KJJ	Radio Shop The 229 Sunnyvale Ave Sunnyvale Calif	X		
KNV	Radio Supply Co of California 815 S Main St Los Angeles Calif	X		
KYY	Radio Telephone Shop The 175 Stewart St San Francisco Calif	X		
WGF	Register & Tribune 715 Locust St., Des Moines Iowa	X		
KLZ	Reynolds Radio Co Inc 1124 University St Denver Col	X	X	X
WHN	Ridgewood Times Printing & Pub Co Inc Chamber of Commerce Bldg Ridgewood N Y	X	—	
WKN	Riechman Crosby Co The 228 S Front St Memphis Tenn	X	X	X
WFO	Rike Kumler Co The Main and 2d Sts Dayton O	X	X	X
WHQ	Rochester Times Union Inc 22 Exchange St Rochester N Y	X	X	X
KNJ	Roswell Public Service Co The 112 W 3d St Roswell, N M	X		
KCY	Ruth Sebastian (St Martin s College) Lacey Washington	X		
KJC	Standard Radio Co 721 S Broadway Los Angeles Calif	X		
WPJ	St Joseph College 18th and Thompson Philadelphia Pa	X		—
WEW	St Louis University 221 Grand and Pine Sts St Louis Mo		X	X
KMJ	San Joaquin Light & Power Corp Tulare and H Sts Fresno Calif	X		
WHW	Seeley Stuart W Weather Bureau Bldg E Lansing Mich			X
WJK	Service Radio Equipment Co The 225 Superior St Toledo Ohio	X		
WSN	Ship Owners Radio Service Inc 519 Granby St Norfolk Va	X		—
WDT	Ship Owners Radio Service 80 Washington St New York City	X		
WNJ	Shotton Radio Mfg Co Inc The 8 Market St Albany N Y	X		
KDPT	Southern Electrical Co 3d and E Sts San Diego Calif	X		
WBT	Southern Radio Corp 905 Realty Bldg Charlotte N C	X	X	X
WCK	Stix Baer Fuller Washington St St Louis Mo	X		
WFI	Strawbridge & Clothier 8th and Market Philadelphia Pa	X		
KQY	Stubbs Electric Co 75 6th St Portland Ore	X		
WBL	T & H Radio Co (P G Thurman) 401 S Anthony St Anthony Kan	X		
WRW	Tarrytown Radio Research Lab 21 23 N Broadway Tarrytown N Y	X	—	—
WGU	The Fair State Adams and Dearborn Sts Chicago Ill	X		—
WRL	Union College Schenectady N Y	X	—	—
WAAF	Union Stock Yard and Transit Co Chicago Ill	X	X	—
WPO	United Equipment Co 600 Monroe St Memphis Tenn	X	—	—
WRM	University of Illinois, Urbana Illinois	X	—	—
WLB	University of Minnesota Minneapolis Minn	X	X	X
WCM	University of Texas Austin Texas	X	X	—
WHA	University of Wisconsin No Charter Madison Wisconsin	X	X	X
WOO	Wanamaker John 13th and Market, Philadelphia Pa	X	—	—
KLS	Warner Bros 2201 Telegraph Ave Oakland Calif	X		—
KHQ	Wasmer Louis 419 19th Ave N Seattle Wash	X	—	—
WOQ	Western Radio Co Kansas City Mo	X	X	X
KOG	Western Radio Electric Co. 7th and Grand Sts Los Angeles Calif	X	—	—
KYW	Westinghouse Electric & Mfg Co 72 W Adams St. Chicago Ill	X	X	X
KDKA	Westinghouse Electric & Mfg Co East Pittsburgh Pa	X	—	—
WJZ	Westinghouse Electric & Mfg Co., 95 Orange St. Newark N J	X	—	—

Call	Station			
WBS	Westinghouse Electric & Mfg. Co., [illegible], Springfield, Mass.	X	—	—
WHD	West Virginia University, Morgantown, West Va.	X	—	—
WJH	White & Boyer, 512 14th St., N. W. Washington, D. C.	X	—	—
WPM	Williams, Inc., Thomas J., 1334 New York Ave., Washington, D. C.	X	—	—
WNO	Wireless Telephone Co. of Hudson County, 307 Bergen Ave., Jersey City, N. J.	X	—	—
KOA	Y.M.C.A., 16th Ave and Lincoln St., Denver Colo.	—	—	X
WKC	Zenvicki, Jos. M., Co., 2227 Madison Ave., Baltimore, Md	X	—	—

April 16 1922 187 Stations

Radio Notes

Radio Service for Fishing Fleet.—Word comes from France to the effect that radio equipment ranging from 200 watts to 1 000 watts capacity is to be installed on more than 200 French fishing schooners. In 1918 there were only 30 fishing boats thus equipped.

Railroad Radio.—While there is nothing fundamentally new to the use of radio on board trains the fact remains that with the present development of the art the application becomes practical at last Tests have recently been conducted by the Delaware Lackawanna & Western Railroad As this issue goes to press we have just succeeded in obtaining photographs and complete information of the interesting installation aboard the train and the results obtained The complete facts will appear in our July issue.

Destruction of Princeton's Radio Station.—A disastrous fire in one of the buildings of the Princeton University recently destroyed a part of the radio equipment. While the loss was amply covered by insurance it was an unfortunate accident since the matter of arranging for a broadcasting service was just about completed. The idea of a broadcasting originated with Mr L S Gatter (1912) and was taken up at once by those in charge of the station The University of Wisconsin and the University of Minnesota already have established broad casting stations for general university news, as well as for results of athletic contests. The set to be installed will having a sending range of 1,000 miles and will operate in 300-meter wave length

An Automatic S.O S. Signal.—Interesting progress has been made in England in the way of developing an automatic device for sending out S.O S. or distress signals at sea. Instead of using the usual telegraph key and sending out the S O.S call, the system is to send out by means of an automatic device a dash of a certain length at regular intervals. Such signals serve to operate an alarm bell on other ships within range and the operator of the ship in distress can then send specific instructions. The important advantage of the new system is that its signals do not conflict with other radio signals, and that it rings an alarm bell on ships in the immediate vicinity Ten ships are already equipped with the new signaling device and 25 more are being so equipped Satisfactory results have been obtained over a radius of 100 miles.

A Filter for Radio.—Although much has been said and written about the remarkable filters employed by the telephone lines and by advanced radio workers for the separation of telephone and telegraph messages, it has remained for Dr Frank B. Jewett, chief engineer of the Western Electric Company to demonstrate how the filter permits of transmitting radio telephone and telegraph messages simultaneously, and of separating these messages at the receiving end at a recent meeting of the American Institute of Electrical Engineers. The present electrical filter is the invention of Dr G A. Campbell, a telephone engineer, and makes it possible to separate the various frequencies at which the individual telephone and telegraph messages are carried. The detected electrical current in a radio receiving set is passed through the filter which separates the frequencies of the telegraph message from those of the telephone The filter differs materially from the ordinary tuned circuit familiar to the radio enthusiast, since it transmits not single frequencies but bands of frequencies of any predetermined width. The filter makes it possible to separate the band of frequencies comprising the telephone message from the band comprising the telegraph message. It will also separate one telephone message from another.

Civil Engineering Notes

A Record Train? A train drawn by a single engine recently brought 165 000 bushels of grain over the Canadian Pacific lines. The train was 0 9 mile long consisting of 110 loaded cars a water car and a caboose The gross weight was 686,000 tons.

The Effect of Temperature on the Rate of Corrosion is practically an unknown quantity But experiments have shown that at 80 degrees Centigrade iron corrodes nearly ten times as rapidly as at 0 degrees The effect of light is very remarkable It has been shown to accelerate corrosion very markedly even after the temperature effects had been removed Corrosion is clearly affected by barometric variation The subject is very complex and the results are not always the same even when experiments are carried out under what appear to be exactly identical conditions

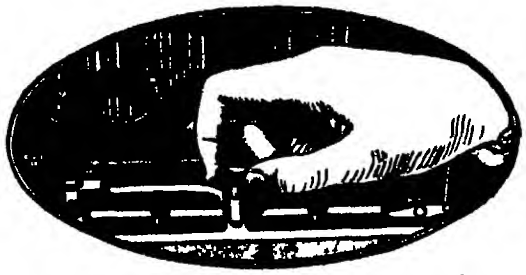
An International Water Dispute of some moment has been settled with the final award of the Joint Commission for the measurement and apportionment of the waters of the St. Mary and Milk Rivers between the United States and Canada By giving Canada the preference in the waters of the former stream and the United States that in the flow of the latter but arranging for a minority interest of each nation in the other's stream the Commission has reached a decision mainly satisfactory to both parties

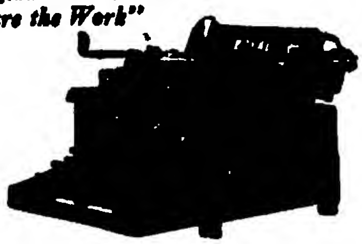
Novel Lighthouse Construction.—A combined lighthouse dwelling and fog signal room for Fairport, Ohio on Lake Erie marks a new method of erecting for exposed locations. The shell of the building was fabricated riveted and bolted permanently together ashore without interior mason work or lantern it was 28 feet square with a 38½ foot tower at one corner and it weighed 65 tons It was moved on the deck of a small steamer 147 miles up the lake to its location at a transportation cost of $1850 The plan is estimated to have saved about $10 000

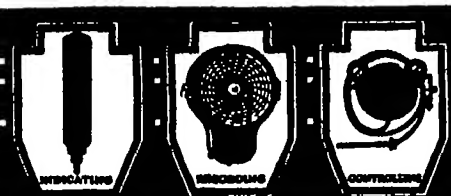
A Heat Treatment Problem.—In the course of a lecture before the Birmingham Metallurgical Society Mr E R Taylor says *Engineering* described an unusual form of trouble which was experienced in the heat treatment of some small engine parts The right degree of hardness failed to develop although the composition was quite up to specification The cause was discovered to be a current of air passing along the bed of the muffle producing a film of oxidation on the surface of the steel The matter was remedied by scattering small fragments of charcoal about the size of peas over the bottom of the muffle the engine parts being put into the muffle on a tray The charcoal became oxidised instead of the steel and the trouble was corrected

Creosoted Sleepers.—It is generally assumed that a bridge built of creosoted sleepers would burn more readily in the event of its catching fire than would a bridge of non heated timber An experience with an 108-foot 9 span creosoted timber ballasted deck trestle bridge on the Nashville Chattanooga & St Louis Railroad in May last disproves this assumption Starting at one end of the trestle and fanned by a high wind the fire spread over the structure rapidly and burned intensely for some time Following the fire, an examination revealed the fact that with the exception of charring which the timbers suffered and the burning of a few braces to a degree which necessitated their renewal the structure was little the worse for its experience

A New Type of Track Torpedo has been officially adopted on all lines of the Canadian Pacific Railway It appeals to all three senses producing on detonation not only a loud report but simultaneously a brilliant flash and a pungent smell It is called meteor and is fastened to the tracks by means of two spring rail clips made of tempered steel or spring brass In this way a firm gripping of the rail head is assured and at the same time a prompt application of the torpedo is made possible It is completely waterproof will stand any atmospheric conditions of heat moisture and frost. It has been subjected to 100 hours immersion and one hour in moist steam at 120 degrees Fahrenheit without deterioration and has been used where the temperature was many degrees below zero with complete success. Special tests have been carried out to ascertain its holding power when placed in position on the rail, and for flying particles likely to cause injury to bystanders. These have all been carried out with satisfactory results.—*Canadian Machinery.*







Science Notes

The Thickest Skin is found on the palm of the hand, where it is 20 times as thick as on the eyelid The protection is proportionately greater in the palms of the working man

Rescuer of Livingstone Dies.—Sir John Kirk, pioneer African explorer and the second white man to see Victoria Falls died at Seven Oaks Kent, on January 15th aged 89 Once on the Zambesi River Sir John saved the life of Livingstone by shooting a hippopotamus that was charging Livingstone s craft

A Great Zoo Planned.—Mrs Harold F McCormick purposes to install in the forest reserve she recently donated to the county a zoological garden modeled after the Hagenbeck *Gardens of Germany* that shall be the finest in the world Dr Josef Hartmann who accompanied Mrs McCormick from Europe has been engaged to survey the location and draw up the plans

In Memory of John Burroughs.—Marshal *Foch* after receiving an honorary degree from Columbia University laid the cornerstone of a building on 155th Street between Broadway and Riverside Drive this was the culmination of a two day program honoring John Burroughs other features of which were a memorial meeting at the American Academy of Arts and Letters and an exhibition of artistic and literary memorabilia

The Municipal Observatory at Des Moines Iowa, which is said to be the only municipal observatory in the world was *opened last August* *The observatory building* is to be equipped by Drake University with an 8 inch equatorial telescope It is to be under the control of the university and open to the public at least three times a week, and at any other time when occasion may warrant.

Telepathy in Vienna.—The vogue of telepathic and hypnotic demonstrations sweeping Vienna has proved so demoralizing to both mediums and spectators that all such seances have been forbidden It is said that actual *crimes* were attempted through hypnotic influence and that many nervous persons were seriously deranged Physicians will be licensed to use such methods but only in remedial treatments

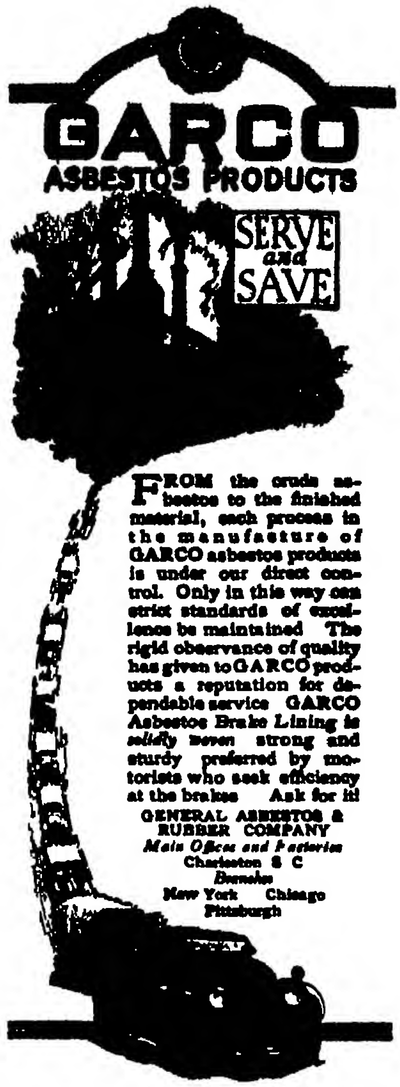
Energy Expended in Marching may be measured by the *volume of* CO_2 *expired over* a 50-meter (54 58 yard) course This is roughly 0061 cubic inches per 2 2046 pounds per horizontal meter (39 37 inches) A soldier weighing 160 pounds and carrying 60 pounds marching 2¼ miles per hour of 50 minutes will expend about 250 calories per hour or 1000 calories in 4 hours over a level course of 10 miles.

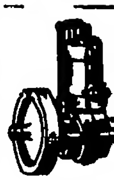
New Vaccine in Pneumonia.—A harmless vaccine treatment requiring three injections at intervals of four or five days has proved its value in the epidemic of pneumonia that accompanied the wave of influenza sweeping New York. This vaccine developed by Dr Park director of the Bureau of Laboratories was distributed to public dispensaries and private physicians as fast as the city laboratories could produce it. It gives protection in a very large number of cases and where an attack does follow its use it is usually a mild one

Safety First Among Children—The Bureau of Education points out that the time to begin inoculating the principles of safety is in the formative period of child life—specifically in the kindergarten It is more important to learn how to move than how to sit still and in teaching children to run about without bumping into each other and into the furniture we have a good beginning toward teaching them to take care of themselves on the streets A traffic game growing naturally out of these diversions lays the basis of respect for law and order

A Tale of Wealth From a Tomb.—Mexican archaeologists are to investigate a strange story concerning the French archaeologist, Count Brisac de Saint Denis who recently died in Paris. It is circumstantially asserted that while doing research work in Mexico near Comala he discovered the tomb of an ancient Toltec king in which was a collection of pearls, opals and gold dust worth $10 000 000 and that he managed to smuggle this wealth out of the country All that is absolutely certain is that the Count did investigate some old ruins near Comala, about 1910.

Sleeping Sickness to be Studied.—The cause of this disease, and the means whereby it is transmitted have long been the subject of study; it remains for the Tropical





Disease Prevention Association to send an expedition to Uganda to investigate its treatment. Four physicians and two veterinary scientists conduct the party, and for several years they will carry out this work in different centers, it is hoped that a general system of vaccination may be developed that will confer immunity on those exposed to the disease.

Facts and the Rain-Maker.—M Angot, director of the French Meteorological Office, has demonstrated that even in the extreme case of two equal masses of saturated air, one at 0° C and the other at 20° C, in order to produce a .04-inch fall of rain it would be necessary for the two masses to mix rapidly and thoroughly throughout an atmospheric layer of four miles in thickness that dust particles and ions (the nuclei of raindrops) are not sufficient of themselves to cause precipitation without an accompanying reduction of temperature The chance of man-made explosions causing rain fall is thus seen to be extremely small.

The Ancient Order of Apothecaries.—Apothecaries were accepted as constituting a distinct branch of the medical profession long before the time of Henry VIII though legal recognition may have come somewhat later The earliest known mention of an apothecary dates back to 1273, when Bardsley, in his "English Surnames," writes, "The Mayor of York was one John Le Espicer aut Apotecarius." This would indicate that the terms "spicer" and "apothecary" were then synonymous, but Chaucer knew them as distinct from one another, the apothecaries confining themselves to drugs, they were originally assistants to physicians.

Bottles and Forest Fires.—A certain "Henry" has been breaking into the newspapers with the claim that bottles thrown away by drinkers are "responsible for starting more forest fires than anything else" These bottles, he says, act as burning glasses by focusing the rays of the sun on dry leaves. Now it happens that a burning glass is an accurately-ground convex lens, without committing ourselves to the statement that never, under any conditions, can a bottle cause a forest fire, we should like to see Henry marooned with a bottle, and to watch his efforts to ignite leaves by its means alone. It's a wonder travelers have not discovered this virtue in the bottle

Ancient Engineering Instruments.—English historical research, as applied to science, brings to light some interesting descriptions of Greek and Roman engineering instruments. Vitruvius cites the use of the dioptra, chorabates, and water levels in surveying, up to 100 A.D., and gives sectional drawings showing these instruments, of which no complete example remains. He also shows the groma an arrangement of two crossed arms at right angles with suspended plumb lines at the ends, used for setting out straight lines and lines at right angles. The dioptra reached an advanced stage of development, and instruments and methods have many striking points of similarity with those of today

German Ambition in Optical Goods aims at nothing less than dominating the world market. Last year the School of Optics and Phototechnique was founded in Berlin so that manufacturers and venders of lenses and specialties might learn the last word concerning their products. Among the new specialties are the lorgnon—a lorgnette with a single eyeglass, often worn fixed to a bracelet by a short chain, and a small opera glass weighing but six ounces, yet having a field of vision more than 25 yards in diameter German optical exports are said to be almost up to pre-war figures and bring returns that enable manufacturers to make exceptionally reasonable prices in the home market.

Glass Kept Clear of Moisture.—The glass of windows, windshields, and goggles soon loses its transparency when moisture is condensed upon it. A recently patented process prevents this by coating the surface of the glass with a layer of transparent, gelatinous substance, insoluble in water under ordinary conditions, which possesses the quality of absorbing and dissipating moisture. This coating may be toughened, softened, or tinted by the addition of other substances. Indoors, the use of the coating on walls hides the discoloration due to "sweating," and mirrors may also be kept clear by the same means. The water vapor has no appreciable effect on the substance, which continues automatically to exercise its alternative functions of absorption and release of moisture for an indefinite time.

When Tables Tip

(Continued from page 406)

festations nor do I expect my readers to accept them off hand Those who may be interested can find the whole story in Dr von Schrenck Notzing's book "The Phenomena of Materialization and Dr Geley's From the Unconscious to the Conscious where the whole account is given and a number of the photographs reproduced

These manifestations are of course the most incredible and the most perplexing with which psychical research deals and they are led up to by a series of simple experiments which have been undertaken in the past, in telekinesis or the alleged movements of objects without contact. For these there is excellent evidence which may be considered conclusive in itself so far as it goes Many of these phenomena depend apparently upon an energy which is radiated from the body and which without contact, moves objects within the immediate environment A medium may place her fingers an inch or so above a metal box say and after holding them from that position for a few moments make a sharp movement and the box will be moved There is thus a sort of vital bridge or connection established between the tips of the fingers and the object in question and this has been proved in several cases in which a medium has succeeded in discharging an electroscope without contact, merely by holding the tips of her fingers an inch or so above it.

There is here it must be admitted a field for legitimate scientific research which borders partly upon the physical and partly upon the biological realms We seem to get very closely into touch with the nature and origin of life and of its active manifestation as well as with the subtle forces which animate the living organism. There is every reason to believe that researches along these lines will eventually culminate in some of the greatest and most startling conclusions of modern science and that these despised and ridiculed psychic phenomena may be the means after all by which we shall be enabled to interpret the nature of life

I have said that manifestations such as these lend themselves to scientific investigation and solution and attempts have been made of late years, to investigate them by laboratory methods just as any other phenomena of physical or biological science are investigated Thus, we have a device which is intended to register the physical pressure of the human *will* A light board some 18 inches in length by 12 inches broad is supported on two knife edges, some distance from the center so that one end of the board weighs more than the other This longer end is supported by means of a thread to a delicate balance which registers the normal weight of the board as it hangs suspended from the scale The subject experimented upon is requested to place the fingers lightly upon the shorter end of the board and look intently at the longer end

Now it will be seen that any pressure exerted by the hands will cause the longer end of the board to move upwards and hence weigh *less* No upward pull can be exercised at the shorter end of the board, for the simple reason that the subject can only remove her hands altogether—in which case the normal weight of the board is registered. *If therefore an increase* of weight is noted this must be due to some pressure exerted on the longer end of the board The subject is told to look at this end of the board intently and to *will* that it shall be depressed and in a certain number of cases (perhaps 2 per cent of those tried) a slight downward pressure is recorded.

Another device known as the Sthenometer is intended to register the vital radiations issuing from the finger tips. A straw is supported on a needle-point so as to oscillate freely in either direction over an indexed circular card A bell jar of glass is inverted over this, so as to shut off air-currents and similar normal forces. The subject is then requested to place his finger-tips close to the glass, opposite the end of the straw and to will that an energy shall proceed from his finger-tips and displace the straw in question. In a certain number of cases, this is readily noted and Dr A. T Schofield, of London, asserts that it is to be noted particularly in hysterical and epileptic cases. It is not the heat of the hands which causes the movement of the straw since, even when the hands are cold this effect is noted and on the contrary a hot iron will fail to move the straw And it is not ordinary electricity for which the glass would act as an insulator. I do not say that the movement of the straw in these cases, is due to any definitely super-normal power, but there is obviously here a case for further investigation, and it is precisely in these odd phenomena that psychical research consists.

I have no space here to deal with other interesting psychic manifestations, such as the human "aura," "thought photography" the experimental projection of the "astral body" weighing and photographing the soul at the moment of death etc. But enough has been said, at any rate, to show that there is here a definite field for legitimate scientific investigation, and that psychical research may in future be classed as a recognized *science* taking its place among other sciences, worthy of the highest efforts of the best minds of the century It is my hope that this will, ere long be recognized, and that psychical research may be regarded as the science which attempts to solve the riddle of man's existence, of his unknown powers as well as his future which no other science attempts to penetrate!

Planning Big Crimes

(Continued from page 388)

of bullion was to be hauled down Wall Street to the docks. This shipment left the sub-treasury in a wagon—it was before the day of automobiles. Dugan and his pals in a lighter vehicle met the official cart between the sub-treasury and the dock. Driving up close they were covered with an assorted variety of hardware in the hands of the wagon guards Flashing his and his pals counterfeit sub treasury badges, Dugan explained that everything was all right. 'There's a plan to hold this wagon up a couple of blocks down Instructions are to unload the bullion into our wagon We will take it to the dock your job is to drive straight ahead and be held up. Give em a fight shoot em like rats and bring them in dead or alive The bullion was transferred and Dugan's wagon drove away The other cart went on looking for hold ups They didn't find any because they had already been held up without knowing it Incidentally the police unravelled this one and sent all hands to the penitentiary

From the ear marks it appears that the first step in planning the recent $2,000 000 post office truck robbery in New York City was to corrupt an employe of the post office. The crooks who used two automobiles to hold up the registered mail truck showed by their immediate and accurate selection of valuable mail pouches taken that they had advance and competent information concerning the shipment They also had what might be termed blue printed knowledge of the route and time of the shipment. It is possible that they actually did have blue-prints because many crooks are good engravers draughtsmen, mechanics They come from all classes and walks of life There is also food for speculation in the thought that the truck was not properly armed or guarded

In planning the corruption of an "inside man in a criminal job of this nature, the crooks make a business of meeting the man to be corrupted outside his business hours. They begin by feeling him out and making him dissatisfied with his position and income. They use Socialistic arguments and stress the vast wealth that can be his if he will depart a little from the "straight and narrow

There is a chance that a pretty girl was used to help corrupt this fellow whoever he is. A pretty girl could be used without her knowledge of the real purposes back of her flirtation She would most likely be of the "gold-digger" type She would be given some money and a big scare. She might be told that unless she did as she was told she would be murdered dismembered and thrown into the bay The actual killing and dismembering has been done in more than one robbery and white-slave case The corpses turn up every now and then to prove it.

What might be called an epidemic of mail robberies has swept the country. I account for this by the "fall" of some former or present employe of the department, who has joined out with some gang of thieves and has spread information through the underworld concerning the methods of the handling of the mails. Such information travels fast. With inside information to work on that would tend to insure success in such robberies, various gangs would rush into the new line of criminal endeavor It would start all the criminal architects and engineers to planning [illegible] and would take them from other work on which they might be engaged. In other words, criminal talent would desert [illegible] for the [illegible] up the new ideas.

INDEX TO VOLUME 126

[illegible] it is impossible to give many cross references, or to enter a given reference in more than one place. Each article is accordingly entered at the place where it is believed it will be most [illegible], in every case the general subject should be sought, rather than the supposed specific title of an article. Frequently articles are not indexed under their specific titles at all, e. g. the article [illegible] will be found indexed under the classification "Forests and Forest Products," and under the specific entry "Rosewood." In every case it is the endeavor thus to place [illegible] that it will be found by one seeking references to the subject discussed in the article. We call special attention to the classifications "Household Appliances," "Machines and Machine Tools," "Machinery and Power," "Machines for Special Purposes," etc., in which many items will be found whose location otherwise would be very puzzling, and which can be examined item for item in the search for a [illegible] entry with much greater ease than can the entire alphabet. The short notes that comprise the columns of text on the advertising pages are indexed only by their general headings, and not specifically for each note. The asterisk (*) indicates that the article in question is illustrated.

The North Atlantic Ice Patrol

(Continued from page 371)

request to all steamships in the vicinity of the Grand Banks to send in their position, course, temperature of sea water, and ice formation Stood across Grand Bank to the southward and eastward for a berg reported on May 9th Stood to east ward and northerly in search of a berg running as far north as 44° 30' without success, subsequently received information that this berg had been caught in the warm northerly current and had broken up into small pieces close to the 45th parallel *Set course to northward and eastward and on* the evening of the 20th located a berg Ran along the eastern edge of the bank during the 21st, and located a small berg The weather shutting in thick, drifted Stood into edge of the bank and anchored with bergs in sight, observing their drift during the 23rd On the 24th steamed to the north ward and eastward to observe two reported bergs. Found them just about sunset when fog shut in thick From the 26th to the 30th worked to westward in dense fog riding out a northeast storm on the 30th and 31st. Fifty-six vessels co-operated with the "Tallapoosa," during the first and second ice patrol cruises. All these vessels crossed the Bank or very close to the danger area and respected the information received It is worthy to note that the steamship "Cassandra," the only known vessel that failed to cooperate or to heed the warnings sent out relative to danger areas, met with an accident by striking a berg"

Such is the work done day by day, and by night by the vessels of the Coast Guard during the three months of ice peril off the Grand Banks.

The World's Wages—a Statistical Anomaly

(Continued from page 369)

In Great Britain, even the agricultural laborers are strongly organized and work but 50 hours a week—an unheard of minimum for farm help.

For farm help, we have in this country two rates "found" and "board out." The latter is used as it seems to be more comparable with foreign practice. In the building trades, averages are taken for New York City where the United States is concerned. The figures would vary for other localities, usually being somewhat less, there is no uniform American rate

With these explanations, we may say that in the United States carpenters get $9 00 per day in Great Britain $3.26 in France, $2.54 in Belgium $1.91 in Japan, $1 87; in Italy, $1 84, in Spain (for 1919, no later figures available), $0.87 in China, $0.30 in Germany $0 24 For plumbers there is no serious discrepancy from the above figures, save for Great Britain where the plumber, perhaps because of the universal British preference for the old fashioned "tub," seems to be at a disadvantage The rates here are, for the United States, $9 00 again, for France, $2.54, for Belgium, $1 67, for Italy, $1.34, for Great Britain $1 06 for China, $0.35, for Germany, $0.25, while Japan and Spain are missing altogether For masons and for painters the wages are the same as for carpenters in the United States, Great Britain, France and Italy In Spain both these trades receive $1 06 and in Germany both get $0.25. The Belgian mason gets $1.82 and his brother of the brush only $1 60 in *Japan the mason has a similar advantage*, of $1.58 against $1 36 in China the mason gets 30 cents and the painter three cents more.

The carpenters seem to be pretty representative of the building trades, both as regards work done and in point of pay received, so we employ them in our graphic comparison of page 369 A wholly different situation exists among agricultural laborers, and calls for a new picture. The figures on which this is based are as follows the farm laborer in the United States gets $3.59, in Belgium, $1.46, in Great Britain, $1.32, in France, $1.20, in Japan, 80 cents, in Italy, 67 cents, in Spain, 39 cents, in Germany, 16 cents, in China nobody knows how little he does get.

Of course, the superficial sum of money paid labor today is universally greater—far greater—than 10 years ago. The French carpenter of 1911 got 9 francs a day and now he gets 28 francs. At par, in 1911, he got $1 73, at 1922 exchange he gets $2.54 But it is doubtful if his wages have kept pace with prices—if he gets as much food or if his wine is as good as ten years ago.

Wool from Cotton

IT is well known that cotton is used to adulterate wool Many a woolen garment contains appreciable amounts of cotton The ordinary person is almost at a complete loss to tell whether a suit of clothes, a dress or coat is made of pure wool or not, and it is only by examination under the microscope that the textile chemist can affirm conclusively the absence or presence of other fibers besides cotton in the garment. Now, there has appeared a patented process whereby cotton is made to assume the properties of wool not only physically that is to feel, appearance and caloric qualities, but chemically as well in its affinity and absorbent capacity toward coloring matters. Pretty soon the chemist himself will be unable to tell the two fibers apart.

These properties are bestowed on cotton when the products of a slow decomposition of protein substances caused by strong mineral acids are fixed on the fiber The results may be obtained in various ways. Either the cotton may first be impregnated with the liquor of dissociation the latter squeezed out and the mineral washed, or else the fabric may be dipped in the protein solutions, then treated with the hydrolyzing liquid, squeezed out and washed The exact order of the steps in the process does not effect the final results

The proteins that are used are casein, egg albumen, serum albumen and gelatine Various strong mineral acids, such as 65 to 80 per cent nitric acid, 55 to 65 per cent sulfuric acid, 25 to 37 per cent hydrochloric acid, etc, are used in hydrolyzing agents either alone or in admixture. Time of immersion and temperature are variable con*ditions which must be regulated according* to the nature of the fiber treated, the particular protein used and the acid that effects hydrolyzation Variation in temperature from 5 degrees C below zero to 20 degrees C above zero has no appreciable influence on the result obtained. The precipitation of the protein substance on the fiber is accomplished by merely washing the treated material in water The process may be used on all vegetable fibers, either in the form of yarns or as fabrics, and it is also immaterial whether the fiber is mercerized or not.

An example of how the process is actually carried out is given in the following A slightly ammoniacal solution of casein is prepared containing about 10 per cent of the protein The fiber is dipped in this solution dried and then exposed to the vapors of formaldehyde for some time. It is then treated for about two minutes with 75 per cent nitric acid at the ordinary temperature, squeezed out or pressed out and washed. The yellow color of xantho-proteid which is developed by a secondary reaction may easily be removed by treatment with a weak carbonate of soda solution

Light Gives the Alarm

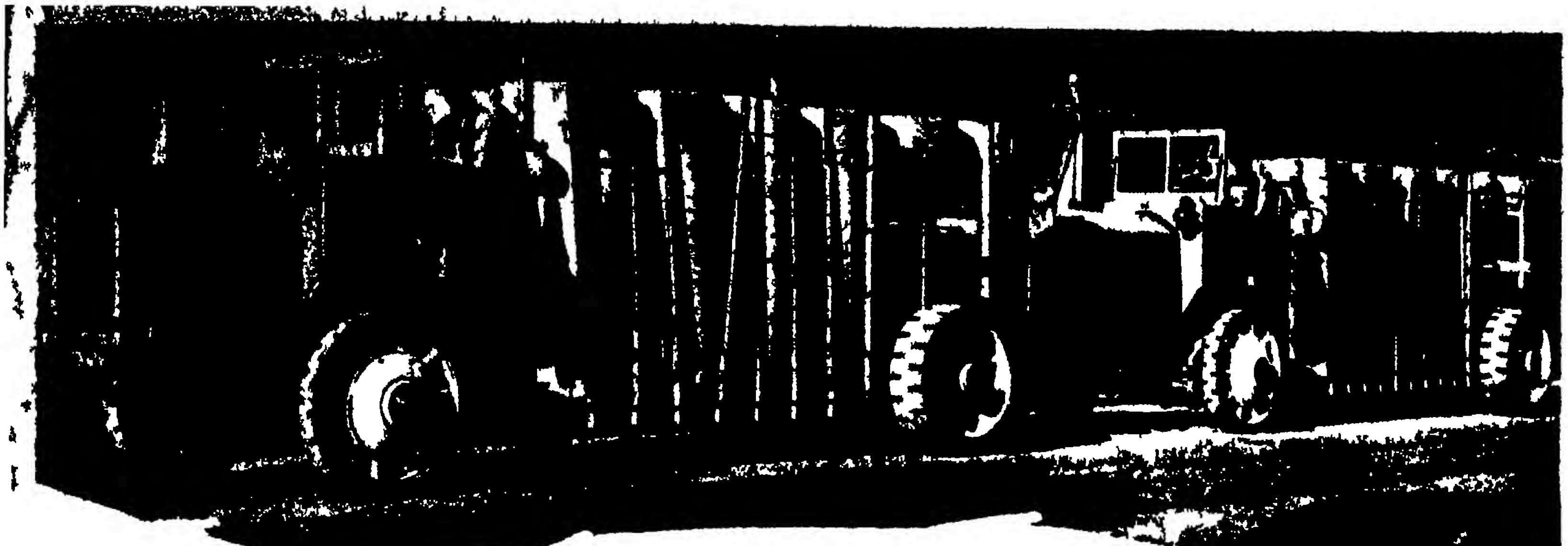
OF all the instruments designed to trap the elusive burglar, a German device, called "the electric eye," is one of the most ingenious. Most burglar alarms are caused to operate by the action of some direct contact, such as pressure on a door or window The electric eye operates quite independently of any such contact, direct or indirect. The inventor of this alarm has taken advantage of the fact that a thief does not usually work in the dark though his step may be stealthy and his touch light and skilled, he almost never fails to carry some kind of a lamp or flashlight to prevent him from stumbling, and to enable him to see just what is worth "lifting." And it is this light which is to be his undoing

The operation of the electric eye is based on the action of selenium. Selenium is a remarkable chemical element, which is known to be a non-conductor of and a resistant to electricity in the dark, but as soon as light falls upon it, it becomes an electrical conductor If it is inserted in an electric circuit, it operates to break off the electric current as long as it is in darkness, but even a faint gleam of light causes the current to go on again.

The apparatus is quite simple. It consists of a small, but highly sensitive selenium cell, in a little box, about six inches square. The cell is inserted in an electric circuit. It is connected up with a special intermediary apparatus, known as the "call," and to another apparatus which is usually spoken of in various mechanisms as the "relay" The call operates with the flow of the current, and starts the contact with the bell which gives the alarm. This bell contact may be installed in the room of a watchman, or several alarms may be installed in various parts of the house so that the alarm may be given in more than one place. The electric resistance of the selenium cell in the dark operates to cut off the flow of the electric current through the conductor so that the alarm apparatus is put out of circuit until a streak of light falls on it

This brings up the question whether ordinary daylight will not operate to give the alarm Of course, special care is taken to prevent this. So long as the room is lighted by daylight or artificial light, the selenium cell is made light-tight by means of a flap. When the room is vacated and is left dark, the electric eye again is inserted into the electric current and the flap over the selenium cell is lifted. Then, because the room is dark, the apparatus is put out of circuit. The device is also operative in a room which is not in absolute darkness, for the susceptibility to light of selenium can be regulated. For example, if light from a street lamp falls in a room, the electric eye can be adjusted to that light so that the electric current is shut off. If additional light is brought into the room, the dim light already there is strengthened and the apparatus is put in operation. Experiments have shown that even the faintest of lights will operate to give the alarm. For this reason, the electric eye may be a protection against fire as well as burglary

The box inclosing the selenium cell is so small that it may be hidden in a hundred inconspicuous places, where it will be unobserved and where it will work effectively It may be placed behind the carved work on a clock, behind a mirror, placed unostentatiously on a pile of papers in a desk, or wherever the imagination of the electrician may dictate. It may be provided with other protective devices which will operate at the instant the bell contact is accomplished. There may be special protective contrivances for safes. There may follow a putting on of all lights. Even after the installation, improvements may be added to the electric eye. And if the thief happens to know of this particular method of alarm, and attempts to disable it by cutting the circuit, his effort is fruitless; for the very act of cutting the conduction will give the alarm.



Has twenty-three trucks on Caterpillars

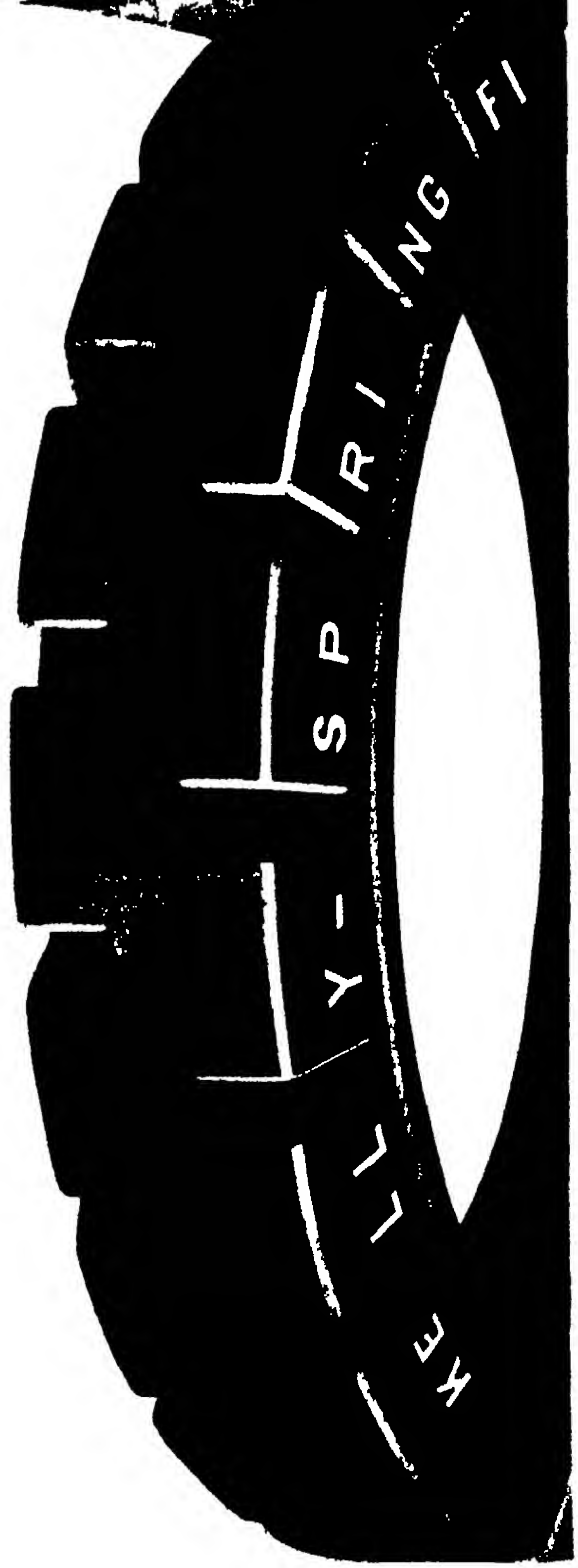
The picture above shows two big MacDonald front wheel drive trucks owned and operated by the Emmons Draying and Safe Moving Co of San Francisco This firm has nine of these trucks and fourteen Federals running on Caterpillars and is equipping the balance of its fleet as fast as the old tires wear out

The picture tells something of the kind of loads these tires have to haul and the service they are giving can be judged from a letter we recently received from Mr W F McLeod, Vice-President and General Manager of this concern

> "For your information our Truck No 75 one of our largest Tractors has completed fifteen months of service on Kelly Caterpillar Tires
>
> "The rear tires are good for another year and we have just replaced the front tires You understand that these new Tractors drive from the front hence the extra wear on the front tires
>
> "We can highly recommend these Caterpillar Tires to anyone needing good equipment and are perfectly satisfied with the service they render us

Wherever traction, power and brute ability to stand up under racking punishment are required, Caterpillar Tires have no competitors. They will take a truck anywhere the engines can pull it with as heavy a load as the truck can carry—and do it at about half the cost of any other type of tire

Caterpillars are made in sizes suitable for trucks of every type and weight



KELLY-SPRINGFIELD TIRE CO.

GENERAL SALES DEPARTMENT

[illegible] NEW YORK, N Y

Fastest Time to Rio *and the* Centennial Exposition

Write for Booklet

Your government wishes the name of every prospective traveler. If you are considering an ocean voyage anywhere send the information blank now—no matter when you intend to go. You will receive without cost the Government's booklet of authentic travel information and description of the U. S. Government ships.

ARE you going? Will you be one of the thousands who will join in the gigantic world celebration of Brazil's 100th year as a republic?

Every part of the world will be represented there. France, Great Britain, Italy, Belgium and our own United States. They will all have exhibits there and will join in the study of the fast developing business opportunities of South America.

If you are going write now and let your Government tell you of its swift new ships which have brought South America 5 to 7 days nearer. These new ships—21,000 ton oil-burners—owned by the U. S. Government, sail from New York fortnightly. Rio de Janeiro is now only 11 days from New York. Montevideo and Buenos Aires are but a few days beyond. South America's treasure chest of pleasure and business opportunities is brought almost to your door.

These splendid new ships are operated for the U. S. Government by the Munson Steamship Lines with 50 years of successful steamship experience.

They are among the finest ships afloat, with spacious staterooms equipped with beds, not berths, electric fans, running water, bed reading lamps. Most have private baths.

Next sailings are:
S.S. American Legion, [illegible]
S.S. Pan America, [illegible]
S.S. Western World, [illegible]
S.S. Southern Cross, [illegible]
Fortnightly thereafter

INFORMATION BLANK
To U. S. Shipping Board
Information Desk Washington, D. C.
A 248

Please send without obligation the U. S. Government Booklet giving travel facts and also information regarding the U. S. Government ships. I am considering a trip to South America ☐ to Europe ☐ to The Orient ☐. I would travel 1st class ☐ 2d ☐ 3d ☐. Going alone ☐ with family ☐ with others ☐. I have definitely decided to go ☐ I am merely considering the trip ☐

If I go date will be about ________

My Name ________

My Business or Profession ________

My Street No. or R. F. D. ________

Town ________ *State* ________

For information regarding accommodations, address

THE MUNSON STEAMSHIP LINES
67 Wall Street, New York City

UNITED STATES SHIPPING BOARD